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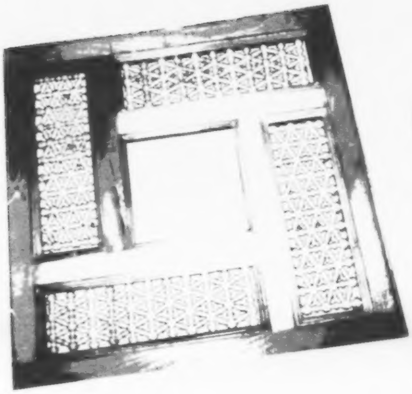
Product development and the environment



- Ecodesign concepts
- Managing ecodesign

- Ecodesign in practice
- Market transformation

- Ecolabelling
- Consumer awareness

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Sustainable products: from re-design to sustainable development

We are all consumers. In our daily lives we ac[illegible] discard the products of industry, most often giving little or no thought to where they come from or where they will go once we have finished with them. Lifestyles in a consulmer society often appear to be based on the mistaken belief that wealth and increased consumption automatically confer happiness on the consumer. Material goods, however, cannot meet all of our social, psychological and spiritual needs. Nor have consumer societies yet discovered how best to help the two-fifths of the world's people who live in or on the edge of poverty meet their fundamental needs.

From the environmental point of view, the products we consume are the tip of an iceberg. Each one entails an unseen environmental burden. It has recently been estimated that, on average, a tonne of goods consumed requires eight tonnes of raw materials for its production. Moreover, products not only require materials and energy during their manufacture; many consume energy and/or pollute, and all must undergo some form of processing or treatment before being returned to the environment. Thus the "throw-away consumer society" is clearly unsustainable. The Rio Conference recognized this fact in the Agenda 21 Plan of Action, which states that "the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production." Any policies and efforts aiming towards true sustainability must address the questions of "what" and "how" we consume.

This double issue of *Industry and Environment* addresses product design and the environment in the broadest sense. Treating this subject in isolation would be to take too narrow a view. Design is part of the product development process, and it must be viewed against the background of the market if it is to be properly understood. Coverage is therefore not limited to the theory and practice of environmentally sensitive product design. Contributions are included from stakeholders involved in market transformation and the management of ecodesign within companies, as well as from those advocating the more holistic concept of sustainable product development.

Reduced to its simplest expression, consumption is a question of supply and demand. Both aspects need to be addressed when consumption patterns and possible ways of changing them are examined. Markets evolve according to a push-pull process in which manufacturers (the supply side) offer products which *push* demand in a given direction; consumer needs and desires (the demand side) then evolve, exerting a *pull* on the market. Product design constitutes an active interface between the two sides, both exerting pressure and responding to it. It is therefore at this pivotal point that environmental issues need to be considered. Concepts such as ecodesign and sustainable product design provide the means to include reduction of environmental impacts among the basic product development criteria.

The term "consumers" does not just cover the domestic sector, consisting of private individuals and households. Governments and industry, sometimes referred to as "intermediary consumers", also have their specific consumption patterns and can be of great importance in bringing about change and in promoting demand for environmentally sound products.

Since Agenda 21 was adopted in 1992, efforts by governments, industry and environmental organizations have raised environmental awareness and progressively changed attitudes to consumption, fostering the growth of "green consumerism" and a demand for sustainable products. This trend has been stimulated by the use of policy instruments which often combine voluntary and mandatory approaches to bring about changes in both supply and demand. Inclusion of environmental considerations in companies' or governments' procurement specifications, and in take-back provisions and labelling (energy and eco) are examples of such instruments which are either already in place or being phased in. Product labels can provide information to consumers to guide them in their choices, in turn helping to influence demand. Market pressure may also be exerted on suppliers, pushing them to improve the environmental performance of their products. Although some ecolabelling programmes have encountered difficulties reaching agreed standards, compounded by the difficulties of obtaining reliable data, they are currently being developed in many countries. The ecolabel is likely to become increasingly influential in the future.

With regard to "intermediary consumers", there is already a visible trend for purchasing departments to implement "green" procurement procedures. For instance, the US government has stipulated that all office equipment must meet specifications agreed between manufacturers and the US Environmental Protection Agency. Such steps exert a considerable and direct influence on potential suppliers bidding for government contracts, as well as influencing other intermediary consumers. In industry, companies which specify compliance with environmental requirements for materials and services obtained from subcontractors are increasingly "greening" their supply chains. This trend will certainly be encouraged by the emergence of new standards such as ISO 14000, as purchasers will be able to insist on certification of their suppliers.

The take-back provision is another instrument of change which is increasingly applied. Germany and Japan already have schemes operating for recovery of cars and large household appliances, and the introduction of mandatory agreements for cars is being discussed in the European Union. Similar discussions are taking place in Europe and Japan regarding the electronics industry, causing suppliers to reflect on the end-of-life aspects of their products.

On the supply side, industry's first response to the combined pressures of new regulations and increasingly "green" demand was to redesign existing products. This was an initial step on the road to what is now known as *ecodesign* (also called life cycle design or, especially in the US, design for environment). Much work was done on specific aspects of particular products, such as: reducing in-use consumption of energy and water by household appliances; increasing the amounts of recycled or recyclable materials used in manufacture; and reducing material intensity for given products. This groundwork provided a basis for development and expansion of the ecodesign concept. As experience was gained, it became possible to extract generic principles. As a result, guidelines, "how-to-do-it" manuals, advice centres, and software tools incorporating life-cycle analysis are now becoming available, allowing companies, of all sizes in virtually all sectors and in all parts of the world, to apply ecodesign principles at every stage of their operations.

Ecodesign has made a considerable contribution to reducing the environmental impacts of consumption. However, some experts believe the concept must continue to evolve if consumption patterns are to be changed sufficiently to achieve true sustainability. This evolution, with ecodesign dovetailing into sustainable product design, will call for radical thinking, including reflection on the very nature of "products". Taking a truly life-cycle view of a product requires a shift away from the conventional model, in which the purchaser acquires responsibility for disposal at the moment of purchase. Extending the supplier's responsibility means companies' becoming increasingly service-oriented, but it can also allow them to capitalize on a service potential inherent in their products. For example, leasing agreements with end-of-life take-back obligations for major consumer items can produce significant material and energy savings for the supplying companies and benefits for consumers. However, if such schemes are to be profitable, companies must be prepared to undertake the stewardship of their products, which means creating the structures for recycling and return to the market and, ultimately, for environmentally sound disposal. Innovative companies are already preparing the ground for this process, and some are reaping the benefits. Just as the market is influenced by the pull of more aware consumer demand, it can also be stimulated by companies able and willing to meet that demand in imaginative ways. The demand for sustainable products undoubtedly exists. By designing and developing products with due consideration given to their full life cycle, business and industry can make a significant contribution to sustainable development. There will be rewards, too, in terms of market share, for those companies whose product designers and developers can incorporate sustainability into their creative thinking. Above all, the reward, for all of us, will be to pass a sound environment along to our children and to future generations. To help curtail the use of ecologically destructive products, and thus fulfill our responsibility to live within the Earth's means and make our life style consistent with sustainability, product design is an important tool.

◆

Facts and figures: products, consumers and design

The vast quantities, and the innumerable types, of products that are available to consumers worldwide make it very difficult to obtain quantified data on the global effects of more environmentally sensitive design. When awareness first began to grow of the environmental impacts of consumption, the response was, quite naturally, somewhat partial and compartmentalized. Analyses and actions were aimed at specific products or processes. There was no all-embracing "ecodesign" approach for products in general. It is only now that such a holistic approach (using life cycle analysis to ensure that all environmental criteria are considered) is beginning to gain wider acceptance. However, product-by-product analyses have led to certain areas being carefully researched. Examples extracted from this research can be used to illustrate some of the fundamental aspects of consumption. The facts and figures presented here, which are mainly from the US and Europe, concern energy consumption by domestic appliances, energy consumption by office equipment, and recycling and end-of-life disposal of cars. Both supply and demand are covered. Consideration is given to improvements of individual products, and policy instruments and other means of exerting a force for change are examined.

Domestic appliances

Domestic appliances are major consumers of energy. Life cycle analysis has shown that three-quarters of their total lifetime energy consumption occurs during use, rather than in manufacture or transport. Research by the Environmental Change Unit at Oxford University indicates that domestic appliances and lighting account for 25 per cent of all of the electricity used in the UK. Consumption in these areas rose by 50 per cent between 1970 and 1994, in spite of a reduction in the size of households. In 1970, an average UK household of 2.9 people used 2000 kWh per year for appliances and lighting, whereas, by 1994, 2.5 people per household were using 3000 kWh per year. **Table 1** puts consumption by appliances and lighting during this period into the overall national context. The US Environmental Protection Agency (EPA) is also concerned about residential energy use. Household energy consumption in the US (including energy for heating) is responsible for 20 per cent of all CO (carbon dioxide) emissions, 26 per cent of SO (sulphur dioxide) emissions, and 15 per cent of emissions of NO (nitrogen oxides).

The amount of energy consumed by appliances varies greatly, depending on their design. This is illustrated by **Table 2**, which shows consumption figures for the "best" and "worst" appliances on the UK market. Comparison of their consumption of electricity shows that systematic use of the most energy efficient appliances would result in a reduction in energy consumption of more than 50 per cent, a clear demonstration of the potential energy savings possible through environmentally sensitive design combined with informed consumer choice.

Table 1
Electricity consumption, UK 1970 and 1994 (TWh)

	1970	1994
Domestic lights and appliances	39.3	71.0
Domestic sector	77.0	100.6
All sectors	192.4	288.5
Domestic lights and appliances as a % of total electricity consumption	20	25

Sources: Dukes 1978:29 and 1995:103 and Decade Report

Table 2
Range on the current UK market kWh pa per household

	Market best	Market worst
Fridge freezer	380	900
Lighting	275	750
Dishwasher	360	660
Oven	150	350
Tumble dryer	160	400
Washing machine	155	400
	1480	3460

Source: Decade Report

Table 3
TV electricity consumption 1970-2020 (TWh)

Year	On-mode	Standby
1970	8.3	0
1980	8.9	0.06
1990	5.3	0.28
2000	4.3	0.36
2010	5.3	0.30
2020	6.2	0.31

Source: Decade Report

Cold appliances (refrigerators and freezers) are the largest energy-consuming category of appliances. In the UK, they consume around 17 TWh per year of energy (about 6 per cent of total UK electricity consumption). International agreements requiring the phasing out of CFCs, HCFCs and HFCs as refrigerants gave an initial impetus to the redesign of cold appliances. Such pressures provided an opportunity for some manufacturers, and governmental and non-governmental bodies, to address the question of energy consumption. Research institutes and NGOs in several European countries produced designs for improving cold appliance efficiency.

Cold appliances use energy to remove heat from the cold-storage cabinet, but about four-fifths of this heat load escapes through their walls and doors. Minimizing losses through walls and doors, and improving refrigeration circuit efficiency, are therefore central to improving efficiency. Experience has shown that improving insulation is more cost-effective than improving refrigeration. Vacuum insulated panels, made possible by a relatively new technology, are one solution. These panels, which have a thermal conductance of between one-quarter and one-eighth that of conventional polyurethane foam, are being developed by companies in Europe and the US. Use of this material in a thick-walled single integrated cabinet could reduce energy consumption for a typical refrigerator (1992 standards) by as much as 83 per cent.

While technological advances can improve energy consumption, they can also have adverse effects. For example, "frost-free" or "auto-defrost" features increase energy consumption by 50 per cent. If incorporation of these features becomes even more widespread, energy consumption by refrigerators and freezers could rise significantly, offsetting the benefits of other improvements.

Wet appliances, comprising washing machines, tumble dryers and dishwashers, use large amounts of energy and water (13 per cent of the electricity used by appliances and lighting in the UK). Cost-effective design solutions exist to improve environmental performance. Some examples are given below.

For washing machines:
- improved water level control,
- improved thermal efficiency,
- reduction of tub-drum clearance.

For dishwashers:
- lower hot rinse temperature,
- lower wash temperature and longer wash cycle,
- alternating spraying of top and bottom spray arm,
- cross flow heat exchanger between water in- and outlet,
- reduced thermal bridges.

Lack of knowledge about usage of dryers makes this category more difficult to assess. However, some possibilities for improvement are:
- higher air flow,
- recirculation of air,
- heat exchange.

The *"brown goods"* market – televisions, video cassette recorders (VCRs) and hi-fi and other audio equipment – is extremely dynamic, with purchasing most often being driven by the desire for the new features which are constantly appearing.

Technical advances over the last 25 years have led to televisions being more energy efficient. It is estimated that the change from valves to transistors and finally to integrated circuit technology has resulted in a drop in power demand by new sets in the UK from around 250 W in 1970 to 70 W in 1994. A similar drop would be expected for hi-fi and other audio equipment. However, as power demand depends very much on usage where audio equipment is concerned, this is difficult to quantify. One of the most significant adverse trends in the design of brown goods, from the environmental point of view, has been the development of remote controls and the accompanying standby function. Standby is a mode of operation in which energy is consumed even when the appliance is not being used for its primary purpose. This means a TV or VCR that is switched "off" using the remote control is in fact still consuming energy, for the mere convenience of being able to switch it back "on" again by remote control. Standby consumption is becoming an increasingly significant part of base-load electricity consumption. It was estimated to account for around 5 TWh per year in the UK in 1994, the equivalent of one large power station. Virtually all TVs and VCRs now have this feature, and the trend is increasing for audio equipment. **Table 3** shows electricity consumption by TVs in the UK in both "on" and "standby" modes, with projections for the future. There is also a trend towards producing sets which do not have an on/off switch. In this case the only way of preventing energy consumption would be to disconnect the set from the wall socket. Research in the European Union indicates that around 55 per cent of users who have a remote control use it to switch their TVs "off". For VCRs, it has been estimated that, in the UK, most sets are on standby 22.6 hours per day, which means they are consuming energy without fulfilling their function 95 per cent of the time.

Design solutions already exist which could reduce standby consumption by TVs and VCRs. Purpose-designed power-supply circuitry could halve standby power demand, and radical redesign of circuitry could produce even greater savings. This has been demonstrated by a Finnish TV manufacturer whose top-of-the-range models have a standby consumption of 0.1 W. Such low consumption will probably remain exceptional, but a more realistically attainable average of 1 W would be a considerable improvement on the present estimated 8 W.

Future developments in such a dynamic market are hard to predict. However, some estimates of potential power consumption improvements are available. Technological developments such as the "home theatre" concept, based on a very large TV screen and integral stereo sound system are likely to increase electricity demand in the future. These systems are already selling widely in the US. In Japan sales of wider screens and integral stereo systems are expected to push average electricity demand to 80 W by 2010.

Policy instruments and energy use by domestic appliances

A variety of policy instruments have been used in different parts of the world to help control and reduce energy use by domestic appliances. Some of these policy instruments are shown in **Table 4**, together with the appliances concerned.

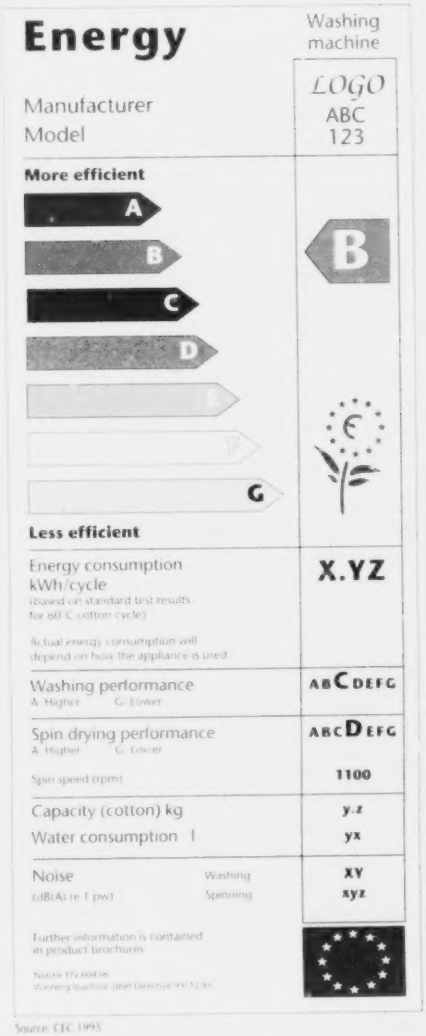
Within the European Union, energy labels are increasingly coming into force. The washing machine label approved by the European Commission, which gives an energy ranking from A through G, is shown in **Figure 1**. As the introduction of such schemes is recent, as yet only limited research has been done on consumer response. Initial results regarding the washing machine label show that some consumers find the label difficult to interpret, as it lists operational aspects such as washing and spin drying performance as well as energy consumption. In addition to the importance of good label design, this finding also highlights a need to train retail staff to guide consumers at the point of sale. Consumer education concerning the use of "Eco" (economy) settings, and the effect of wash temperatures and loading levels, also has considerable potential for savings.

Table 4
Examples of policy implementation world-wide by appliance group

Appliance	INFORMATION Information and advice	Labels	INCENTIVES Rebate or subsidy	Procurement	REGULATION Voluntary agreement	Efficiency standard
Refrigerator		✓	✓	✓	✓	✓
Freezer		✓	✓	✓	✓	✓
Fridge-freezer		✓	✓	✓	✓	✓
Washing machine		✓	✓	✓	✓	✓
Dishwasher		✓	✓		✓	✓
Tumble dryer		✓	✓ (gas)	✓	✓	✓
Lighting	✓	✓	✓	✓	✓	✓
Oven		✓			✓	✓
Hob		✓	✓		✓	✓
Microwave						
Kettle						
Televisions				✓	✓	
Videos					✓	

Source: Decade Report

Figure 1
EU Energy label for washing machines



Source: CEC 1995

An energy label has been compulsory for cold appliances in the UK since January 1995. It is based on the same model as that for washing machines, although it is a little less complex. It appears to be somewhat more successful in influencing consumer decisions. In a limited poll carried out by the Environmental Change Unit at Oxford, 35 out of 100 purchasers of cold appliances said they had been influenced by the energy label. The appliances they purchased were, on average, 20 per cent more energy efficient than those chosen by consumers who indicated they were not influenced by the label.

Office equipment

The explosion in the use of electronic office equipment in recent years has increased energy consumption in the commercial sector dramatically. In fact, it has been estimated that in developing countries office equipment probably uses more electricity than steel-making furnaces. Research has shown that much of the electricity consumed by office equipment is wasted, with machines often standing idle. For example, a photocopier which is left on all day during office hours (but is very unlikely to be producing copies all of that time) consumes more electricity annually than a domestic refrigerator-freezer.

While it has long been recognized that domestic appliances use a great deal of electricity, it was only towards the end of the 1980s that awareness of consumption by office equipment began to grow. However, attempts are being made to address this problem and policy instruments are being used to influence manufacturers to concentrate on improving their designs. A description of one such instrument is given below.

ENERGY STAR® for Office Equipment – an example of a successful programme

Under the US Environmental Protection Agency's Energy Star for Office Equipment programme, manufacturers agree to produce office equipment which switches to a low-power state when inactive. The standards with which they

Table 5
Summary of PC and monitor specifications
US EPA Energy Star programme

	Monitors	Personal computers	All-in-one units(1)
Maximum watts in low-power state	30	30	60
Power management preset default times	15-30 minutes	15-30 minutes	15-30 minutes

(1) 60 watt maximum is permissible only if the computer and monitor function as one system or unit and components cannot be separated.

Source: EPA

Table 6
Summary of printer and fax machine specifications
US EPA Energy Star programme

Market segment (pages per minute)	Average watts in low-power mode	Printer default time	Fax default time
0 < ppm < 7	15 W	15 minutes	5 minutes
7 < ppm < 14	30 W	30 minutes	5 minutes
> 14 and high-end colour	45 W	60 minutes	15 minutes

Source: EPA

comply are shown in **Tables 5 and 6**.

Although the programme is voluntary, its effects were certainly reinforced by a Presidential Executive Order which came into effect in October 1993, directing all US government agencies to use only desktop computers, monitors and printers that meet EPA Energy Star guidelines. By the first quarter of 1996, market penetration of the programme in the US was estimated at: 70 per cent for computers; 93 per cent for monitors; 98 per cent for printers; 95 per cent for fax machines; and 40 per cent for copiers. In all, around 650 office equipment manufacturers from 14 countries were participating in the programme, representing a "critical mass" of manufacturers worldwide which included all of the most important. The companies participating use the Energy Star logo on their equipment and in advertisements, brochures and catalogues.

The automobile – design for recycling and disposal

In 1990, 32 million vehicles were scrapped worldwide. It is expected that by the year 2000 this number could increase to 55 million. The normal disposal process is to strip off all the parts which can be recovered and recycled and send the denuded wreck to a shredder mill, where it is reduced to small pieces, some of which are recoverable scrap. Residual shredder waste generally represents about 25 per cent of the weight of a vehicle as supplied to the shredder. For a car, this is of the order of 200 kg. The waste typically contains: plastics, textiles, glass, rubber, paint, adhesives, wiring, insulation material, underseal and dirt. It is frequently disposed of in landfills.

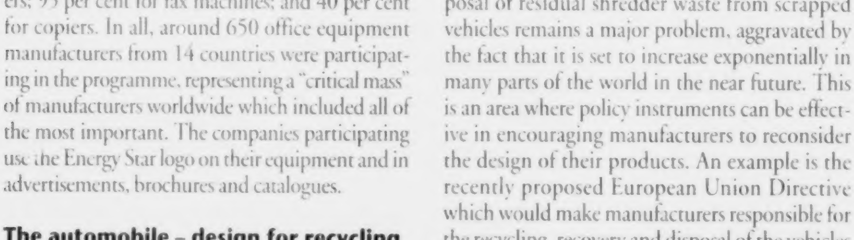
In recent years there has been a trend towards increasing the amounts of new light alloys and plastics used, in order to make the car lighter and thus reduce fuel consumption. However, these design decisions have had an adverse effect with regard to the quantities of waste produced, as many such materials are far more difficult to recycle than the traditional metals (**Figure 2**).

Some automobile manufacturers, recognizing the need to address the waste problem, have begun to incorporate waste reduction into vehicle design. Favoured methods are coded stamping of plastics and selective dismantling, which involves removal and recovery of fluids and parts which can be reused. In Europe, use of these and similar methods has led to a recycling level for cars of around 75 per cent.

Policy instruments and car design

In spite of the efforts made by manufacturers, disposal of residual shredder waste from scrapped vehicles remains a major problem, aggravated by the fact that it is set to increase exponentially in many parts of the world in the near future. This is an area where policy instruments can be effective in encouraging manufacturers to reconsider the design of their products. An example is the recently proposed European Union Directive which would make manufacturers responsible for the recycling, recovery and disposal of the vehicles they produce. The proposed Directive would oblige manufacturers to take back scrapped vehicles; to achieve reuse and recovery targets of 85 per cent by 2002 (and 95 per cent by 2015); and to design all new vehicles after 2002 with 90 per cent reusable or recoverable materials. Interestingly, this proposal is already exerting a market force in Japan. Two major Japanese car manufacturers recently announced that they intend to achieve a recycling rate of 90 per cent of car body parts by the year 2000, two years before European manufacturers would be obliged to recycle at a rate of 85 per cent. The reason given was the need felt by Japanese manufacturers to combat the steadily increasing rate of penetration of their domestic market by European cars, bought because they are perceived as more environmentally friendly than domestic models. For these manufacturers, market intelligence indicates that consumers now feel that safety questions have been satisfactorily addressed and that environment will be the next concern.

Figure2
Development of automotive material selection



Source: Collected Papers Rec '93

Future trends

These facts and figures have only covered a tiny part of the vast subject of present-day consumption patterns. However, cases like that of the Japanese car manufacturers are a sign that major industries are becoming aware of the growing demand for environmentally sound products. The increasing attention paid to the environment in advertising for many other products is a clear indication that this awareness is not limited to the automobile market. Almost all experts agree that, although the phenomenon is hard to quantify, the green consumer undoubtedly exists worldwide and is having a real effect on transforming demand. Increased environmental awareness will make green demand more pressing in the coming decades.

Like green consumerism, the use of policy instruments also looks set to expand. Recent reports indicate that, in addition to the EU Directive mentioned above, several European countries are considering introducing mandatory take-back in the electronics industry. The Japanese Ministry of International Trade and Industry (MITI) is also working with manufacturers to increase recycling rates and is investigating extending manufacturer responsibility for disposal of major household appliances. Although there does not yet seem to be any intention to introduce such instruments in other Asian countries at present, laws made in the west may have a knock-on effect. For example, if companies buying components in Asian countries become subject to take-back legislation, they may well ask their Asian suppliers to take back these components, making take-back an established industrial practice.

As awareness of the importance of product design and development in changing consumption patterns has grown, there has been a parallel development in the methods and tools available to help designers integrate the ecodesign approach into their work. Life cycle assessment (a tool allowing an integrated analysis of the environmental performance of products from cradle to grave) is becoming an increasingly accepted concept. Tools such as product-design software, guidelines and manuals which show how to apply life cycle assessment are increasingly helping in the search for creative ideas which are both innovative and environmentally sound. The importance of such tools is likely to increase in the future as companies eager to keep up with or even preempt legislation are pushed to develop sustainable products. As one executive from a major North American electronics company said, "We are stepping up the design for the environment side of things. It's *the* single activity that will prepare you for all of the legislation coming." ◆

Incorporating environmental issues in product design and realization

Bert Bras, Systems Realization Laboratory, The George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0405, USA

Abstract

An increasing number of corporations, designers and engineers agree that the question is not whether they *should become environmentally responsible in product design and realization, but* when *and* how. *Some of the relevant issues and options that need to be considered are described here. Education is the indispensable prerequisite for incorporating consideration of environmental issues in product design and realization.*

Résumé

Un nombre croissant d'entreprises, de designers et d'ingénieurs s'accordent sur le fait que la question n'est pas tant de savoir s'ils *doivent tenir compte de l'environnement lors de la conception et de la fabrication, mais* quand *et* comment. *Certaines des questions et options à considérer dans ce contexte sont ici présentées. L'éducation est un préalable indispensable pour intégrer la prise en compte des questions d'environnement dans la conception et la fabrication des produits.*

Resumen

Un número cada vez mayor de empresas, diseñadores e ingenieros concuerdan en que no se trata de saber si deben lograr ser responsables del diseño y la realización de productos en materia medioambiental, sino cuándo *y* cómo. *Algunos aspectos y cuestiones que deberán ser analizados serán tratados aquí. La educación es un requisito previo indispensable para incorporar el estudio de los asuntos medioambientales en el diseño y la realización de productos.*

From design for manufacture to design for the life cycle and beyond

One can argue that the "good old days" when a product was designed, manufactured and sold to the customer with little or no subsequent concern are over. In the 1970s, with the emergence of life cycle engineering and concurrent engineering in the United States, companies became more aware of the need to include serviceability and maintenance issues in their design processes. Concurrent engineering has been defined as "a systematic approach to the integrated, concurrent design of products and their related processes, including manufacturing and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements." Although concurrent engineering seems to span the entire life cycle of a product according to the preceding definition, its traditional focus has been on design, manufacturing, and maintenance.

Perhaps one of the most striking areas where companies now have to be concerned is the environment. The concern regarding environmental impact stems from the fact that, whether we want it or not, all our products affect in some way our environment during their life-span. In **Figure 1** a schematic representation of a system's life cycle is shown. Materials are mined from the earth, air and sea, processed into products, and distributed to consumers for usage, as represented by the flow from left to right in the top half of the figure.

In general, environmental impact comes from (excessive) consumption of natural resources and emissions of pollutants to air, water and land. We are all familiar with the negative effects of air emissions. Recognition of their effects has led, among others, to the Clean Air Act and Corporate Average Fuel Economy legislation in the United States. However, recently end-of-life and disposal issues have received more attention. The emergence of product take-back legislation in Europe (for example, the German Closed-Loop Economy Law) has forced manufacturers to think more and more about how to dispose appropriately of their products through recycling and reuse (as represented in the flow from right to left and up in the lower half of Figure 1) and to include product retirement issues such as recycling and disassembly as a real requirement in their design process. The term "demanufacture" is often used to characterize the process opposite to manufacturing necessary for recycling materials and products. Material demanufacture refers to the process of breaking down long polymers into smaller polymers, which are then used for stock in new materials.

There are several motivating factors for a company or organization to become more environmentally responsible. Some of the most notable are:

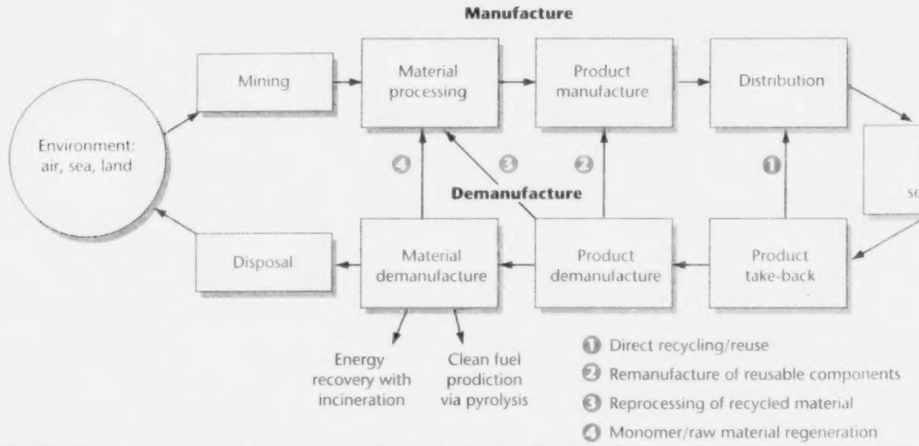
- *Legislation*. For example, the US Clean Air Act has limited the use of a number of materials and (European) take-back legislation is driving Design for Recycling efforts.
- *Customer demand*. Awareness of environmental issues is increasing among customers. Some customers will even pay more for a product if it is green. Also, industrial customers (for example, Original Equipment Manufacturers) do not want (future) environmental liability for a supplier's product.
- *Eco-labelling programmes*. How "green" is a product? Having an eco-label becomes a competitive advantage.
- *ISO 14000*: The ISO 14000 (environmental management standards) certification may become a crucial element in doing business, like ISO 9000 (quality management standards).

In addition, many have noted that "Design for the Environment" (DFE) makes good business sense and has many other positive effects. For example, the reduction of material diversity leads to less diverse inventory, volume purchasing, and the opportunity to focus on a reduced number of (core) manufacturing processes. Life extension practices place renewed emphasis on design for serviceability, which typically pleases customers. Environmental concerns are also stimuli for finding new creative solutions and products. However, this does not imply that one can always expect a financial reward from becoming environmentally responsible.

Many companies and organizations have realized the need to become more environmentally responsible. However, many are struggling with the questions of how to move towards becoming a more environmentally responsible company in general and how to include environmental issues in product design in particular. There is no unique solution, but in order to move towards integrating environmental issues in product design, a company should ask itself (at least) the following questions:

1. What are the organizational motivation and targets for integrating environmental issues?
2. What are the (current) organization capabilities and state?
3. What new practices, tools, and organizational structures are needed?
4. What is the best way of implementing the necessary changes?

Figure 1
A generic representation of a product's life cycle from cradle to grave and reincarnation


Manufacture
Mining
Material processing
Product manufacture
Distribution
Environment: air, sea, land
Use + service
❹
❸
❷
❶
Demanufacture
Disposal
Material demanufacture
Product demanufacture
Product take-back
Energy recovery with incineration
Clean fuel prodiction via pyrolysis
❶ Direct recycling/reuse
❷ Remanufacture of reusable components
❸ Reprocessing of recycled material
❹ Monomer/raw material regeneration

5. What are mechanisms for continuous assessment, feedback, and improvement?

The purpose of this article is to illustrate a number of options and issues that companies and organizations should consider in answering the preceding questions. Specifically, the focus is on the following:

- A number of approaches for reducing environmental impact are discussed in order to provide a view of the current technology base.
- A number of organizational issues are highlighted to illustrate issues to be considered when identifying an organization's capabilities and state.
- General characteristics, representative examples, and integration and information management issues in regard to design tools supporting environmentally conscious product design are discussed.

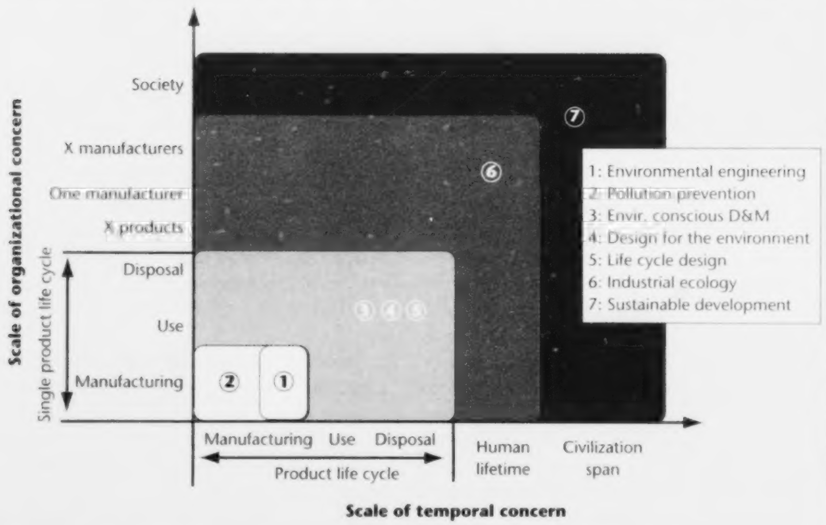
As will be shown, for a more comprehensive integration of environmental issues it is necessary to increase the scope of temporal and organizational concern of product design and realization.

Approaches for reducing the environmental impact of products

In the last decade, the number and variety of persons and organizations working on addressing environmental problems in engineering and industry has grown significantly. The general goal of environmentally conscious approaches to product design is the reduction of the negative environmental impact of a product throughout its life cycle. Several general approaches to reducing negative environmental impact can be identified. They can be distinguished by differences in the scope of organizational and temporal concern, as shown in **Figure 2**. Ideally, one would like to move from the lower left corner (arguably the current state of practice) to the upper right corner and achieve sustainable development. In this figure, rather than indicating years, the temporal concern gradations are based on life-spans of products, people, and civilizations. The scale as shown is not linear, but is used to indicate important distinctions between the approaches. Within a product life cycle an additional set of distinctions are made indicating manufacturing, use and disposal as possible lengths of temporal concerns. It is recognized that a product life cycle could be as short as one to two years for consumer electronics products or longer than 30 years for an airplane or ship, and that the application of a given approach might change accordingly. Similarly, the scale of environmental concerns was chosen to indicate distinctions. These gradations are fairly self-explanatory; although it is worth noting that "X Products" refers to the negative environmental impact of a group of products and that a scope equivalent to "One manufacturer" would indicate concern about all the activities of a single manufacturing firm, whereas "X manufacturers" indicates activities among a group of manufacturers. We note that three classes of approaches can be identified, namely:

- those which are applied *within* a single product life cycle and focus on *specific* life cycle stages;
- those which focus on a *complete* product life cycle and cover *all* life cycle stages; and
- those which go *beyond* single product life cycles.

Figure 2
Environmental and temporal scale of environmental impact reduction approaches



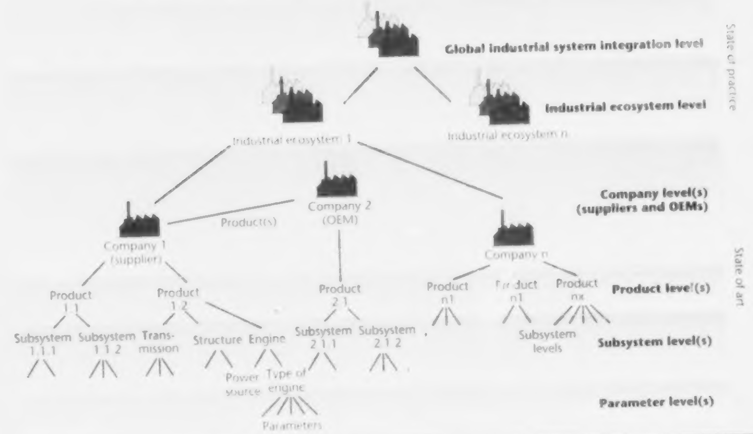
Approaches focusing on specific product life cycle stages

Traditional environmental engineering is concerned with managing the fate, transport and control of contaminants in water supplies and discharges, air emissions, and solid wastes. In the manufacturing context, the focus of environmental engineering effort is after pollutants have been generated, or at the "end of the pipe".

Practised in industry, pollution prevention usually focuses on elimination of pollutants from existing products and process technologies. Pollution prevention efforts are often mandated by legislation. For example, US regulations require pollution prevention programmes for companies emitting hazardous substances. Pollution prevention efforts are broader than traditional environmental engineering efforts, as indicated in Figure 2.

With the exception of Design for Environment, environmentally oriented Design for X approaches (such as Design for Recycling, Design for Disassembly, etc.) are also focused on a specific aspect of a product's life cycle. Although DFX approaches are well known and in many cases well accepted in product design, one danger of focusing too much on specific DFX approaches (or specific aspects of a product life cycle in general) is that strong concentration on a single environmental aspect may negatively affect other aspects and render the product less environmental friendly as a whole. For example, the shift from thermosets towards better recyclable thermoplastics in car design may be counter-effective in certain cases because, in order to compensate for the diminished strength of the thermoplastics, their mass has to be increased, leading to potentially higher emissions from the manufacture of the plastics and a heavier product needing more transportation energy, and thus an increase in the overall environmental impact of the product, even though recyclability is increased. This has led to the development of approaches which focus on a complete product life cycle.

Figure 3
Increasing levels of organizational design concern



Approaches focusing on a complete product life cycle

It is generally agreed that environmental considerations cover a product's entire life cycle and that a holistic, systems-based view provides the largest capability for reducing environmental impact of both products and associated processes. In Design for Environment, Life Cycle Design, Environmentally Conscious Design and Manufacturing, and Green Design, the scope of considerations, both in terms of time and of the environment, is the life cycle of one product (see Figure 2 and also Figure 1). Environmental concerns include all phases of this life cycle, extending beyond the scope of pollution prevention to include the negative impact resulting from the use and disposal of this product. Similarly, the time scale considered is that of the product life cycle, from design and manufacturing through use and final disposal or recycling of the materials in the product. All these approaches have similar goals and encourage a holistic product view. However, it has already been recognized by many that this may not be enough. For example, modern manufacturers often rely on multiple suppliers and have multiple product lines and multiple facilities, often in multiple countries.

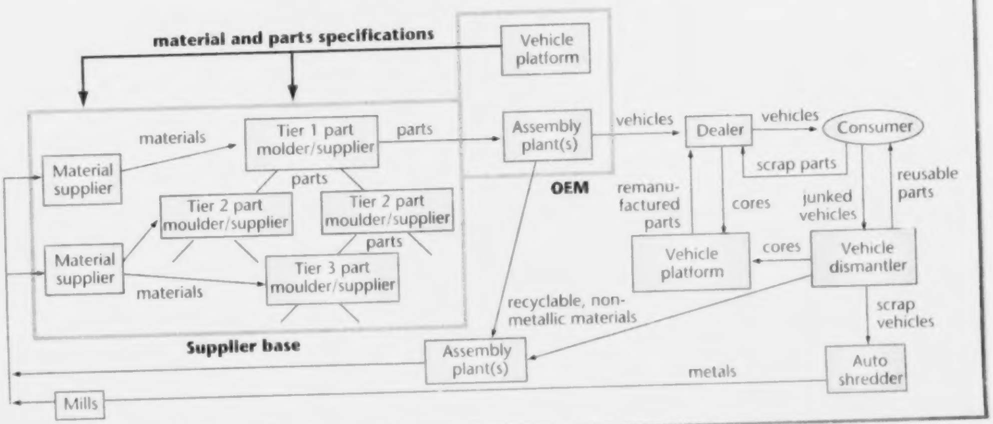
Approaches going beyond single product life cycles

In contrast to the preceding approaches, industrial ecology is not limited to a single product life cycle but considers the interactions of several product life cycles (of possibly different lengths) over a larger time scale. Industrial ecology provides an integrated systems approach to managing the environmental effects of using energy, materials and capital in industrial ecosystems analogous to the metabolism (use and transformation) of materials and energy in biological ecosystems. In industrial ecology, companies, organizations and communities work together to minimize environmental impact and use each other's waste in an intelligent manner to create new products. For example, a carpet industry's production waste can be used by car companies to make sound-deadening materials. On the other hand, polyurethane seat foam taken from recycled cars can be further processed into carpet underlayer. In this example a carpet manufacturer, a car company, and a seat recycling company have a symbiotic relationship like that found in biological ecosystems and have formed what is termed an industrial ecosystem. Moving towards industrial ecology generally requires cooperation between several industries (a vertical move in Figure 2).

The broadest approach, in terms of the scope of environmental and temporal concerns, is sustainable development and technology. The United Nations' Commission on Environment and Development, in their report *Our Common Future*, defines sustainable development as "development that meets the needs of the present generation without compromising the needs of future generations." Sustainable development has been adopted by the Clinton Administration in the US. It is also the least well defined approach in terms of tools and methods. It is generally agreed that sustainable development requires at least pollution prevention, consideration of life cycle consequences of production, and an approach that imitates natural or biological processes. The Natural Step, a Swedish non-profit organization, has postulated a number of system conditions for sustainability based on the Laws of Thermodynamics.

In general, environmental impact reduction approaches extending beyond a single life cycle (industrial ecology, sustainable development) have been implemented at more of a management level, with general strategies proposed but little indication of implementation details. For example, it is difficult to find an example of industrial ecology which illustrates the entire scope of this approach; implementation on a multi-product life cycle scale does not appear to have been done. Most work described as applications of industrial ecology, for example, instead indicate the use of this general approach at the level of a single-product life cycle. True implementation of the approach would require integration of the product life cycles for multiple products. With respect to the current organizational capabilities and state of companies, most larger companies in the US will have pollution prevention practices in

Figure 4
Vehicle life cycle and industrial interest groups



place and are moving towards approaches such as Life Cycle Design in Figure 2. Some companies have started to embrace the notion of sustainable development. Many smaller companies are still struggling in the lower left corner of the figure.

As an aside, we have found the map in Figure 2 to be an extremely effective way of communicating the differences in approaches and overall goal for the following reasons:

◆ The map clearly indicates the key differences between different approaches, namely organizational and temporal scale.

◆ The map also indicates that broader approaches still include principles from more focused approaches. For example, pollution prevention is and should be part of Design for Environment.

◆ As a rule of thumb, the darker the region in Figure 2, the less established the approach is.

◆ The map also provides a means for assessing the current state of an organization and what the overall target and roadmap are. For example, a company with a well established pollution prevention programme which is interested in moving towards sustainable development should first become well versed in environmentally conscious design and industrial ecology prior to reaching sustainable development.

Organizational aspects of integrating environmental issues

A company or organization seeking to integrate environmental issues in product design needs to consider its organizational capabilities and structure. Furthermore, in many cases the company or organization relies on others to do the product design, or at least part of it. In such cases, outreach to other companies and providing leadership or stewardship becomes on integral part of integrating environmental issues into product design.

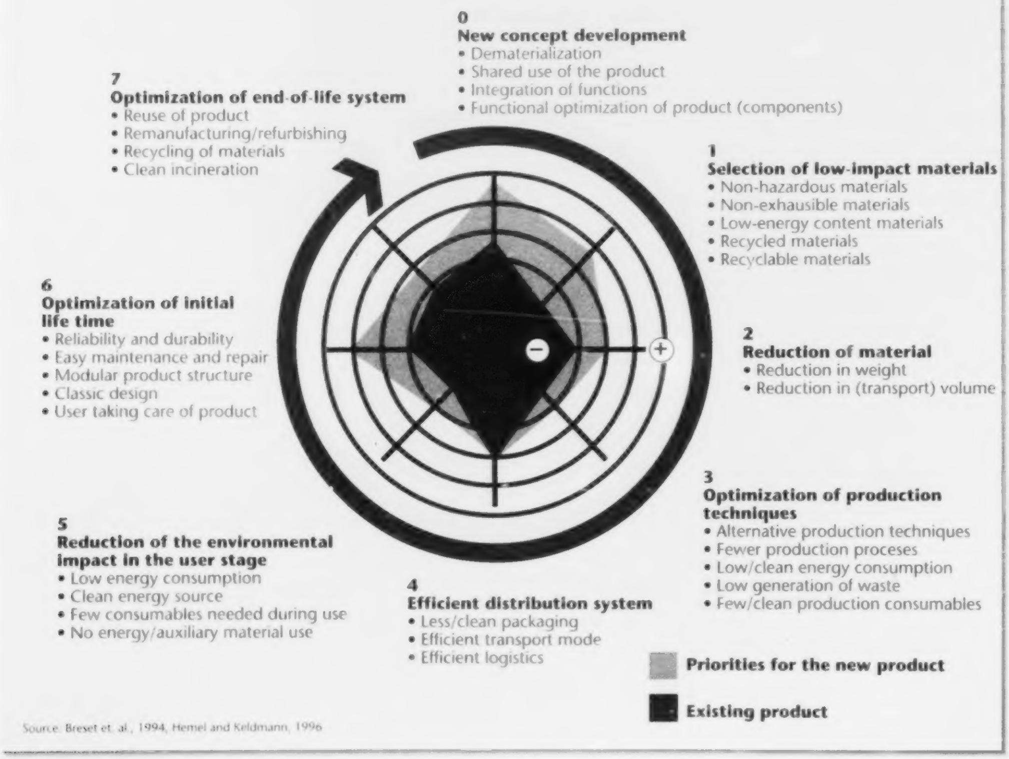
Generally speaking, modern product design is always trying to get a better and cheaper product out in less time. Product design is typically multidisciplinary and multi-leveled. In **Figure 3**, different levels of design concern and integration are shown. At the lowest level the various parameters (for example, the size of a crankshaft) are determined, whereas at the subsystem level components and/parts are integrated into subsystems (for example, into an internal combustion engine). At the product level various subsystems are integrated into complete products, which are either a) sold by a supplier to an Original Equipment Manufacturer for inclusion in their products (for example, an engine and transmission are combined to form a powertrain to be sold to a car manufacturer) or b) directly to a customer (for example, a car from an automobile manufacturer). Clearly, to achieve the technically, economically, and ecologically best product in the least time, communication between the various levels of product realization in Figure 3 is a must. For example, if an OEM decides to eliminate cadmium and zinc coatings, it will affect their suppliers. Many large OEMs, for example in the electronics and automotive industries, have very close working relationships and share design information with their suppliers in order to decrease lead time and cost and increase quality. However, many smaller companies do not have their own design department. Hence they will have to rely on others, such as engineering consulting firms.

The next levels are less well established. At the company level(s), design information is shared bilaterally between suppliers and OEMs, but material in the form of products flow only from suppliers to OEMs. The industrial ecosystem level is characterized by the fact that material flows are shared between companies and a biological metabolism of waste is mimicked. Perhaps the highest level of industrial organization is a global industrial system integration where several industrial ecosystems cooperate at a global level. Needless to say that we are far from achieving the latter level of integration, nor do we know whether it is even desirable. However, we do see a trend in many places towards industrial ecosystem. The Kalundborg industrial ecosystem in Denmark is a well cited example. One advantage of forming an industrial ecosystem is that the focus changes from merely minimizing waste from a specific process or facility to minimizing waste produced by the larger system as a whole. Arguably, by cooperation in an industrial ecosystem, the participants will achieve a greater waste reduction and/or material use efficiency than as isolated elements. In fact, in an industrial ecosystem, one element of the system may actually produce more waste than before, as long as the other partners are capable of absorbing it and the overall waste output of the system is reduced.

As an example of close cooperation with life cycle partners, consider the automotive industry. In **Figure 4**, an overview of a car's life cycle is shown with corresponding interest groups and (basic) material flow. This can be thought of as an industrial ecosystem, albeit nobody would currently refer to it in that fashion. The automotive industry is a classic example of an OEM with a large supplier base. More and more automotive component design is outsourced to suppliers. We can see a definite movement towards increased sharing of information and even material. For example, car manufacturers now encourage suppliers to take back their products for recycling.

Figure 4 exemplifies the amount of interactions that product designers need to consider when pursuing environmentally conscious design. Indeed, some automobile companies are very active in educating their design engineers about the effects of their design on pollution prevention and end-of-life concerns. Part of this knowledge stems from close collaboration with dismantlers,

Figure 5
LiDS wheel


0
New concept development
• Dematerialization
• Shared use of the product
• Integration of functions
• Functional optimization of product (components)
1
Selection of low-impact materials
• Non-hazardous materials
• Non-exhausible materials
• Low-energy content materials
• Recycled materials
• Recyclable materials
2
Reduction of material
• Reduction in weight
• Reduction in (transport) volume
3
Optimization of production techniques
• Alternative production techniques
• Fewer production proceses
• Low/clean energy consumption
• Low generation of waste
• Few/clean production consumables
4
Efficient distribution system
• Less/clean packaging
• Efficient transport mode
• Efficient logistics
5
Reduction of the environmental impact in the user stage
• Low energy consumption
• Clean energy source
• Few consumables needed during use
• No energy/auxiliary material use
6
Optimization of initial life time
• Reliability and durability
• Easy maintenance and repair
• Modular product structure
• Classic design
• User taking care of product
7
Optimization of end-of-life system
• Reuse of product
• Remanufacturing/refurbishing
• Recycling of materials
• Clean incineration
−
+
Priorities for the new product
Existing product

Source: Breset et. al., 1994, Hemel and Keldmann, 1996 recyclers, and remanufacturers. Clearly, an important issue to consider is to what extent will suppliers and product realization partners have to change if a company decides to move towards sustainable development and to integrate environmental issues in its product design and realization practices.

Tools supporting environmentally conscious design

General issues and selection criteria

The number of tools for supporting specific aspects of environmentally conscious design, life cycle design, and DFE have increased significantly. For example, a decade ago there were no tools for assessing the disassemblability and/or recyclability of a product, whereas currently there is enough variety for benchmarking. Any company or organization seeking to integrate environmental issues in product design and realization should ask itself the following questions:

- What new tools should we provide designers to aid them in coping with this increased emphasis on designing for the life cycle?
- How can these tools best be integrated into the existing and well established design systems, tools and practices?
- How do we minimize overlap and increase efficiency in information gathering and management?

The goal of introducing new tools should be to provide efficient and effective decision support in environmentally conscious design, where efficiency is a measure of swiftness and effectiveness, on the other hand, is a measure of completeness and correctness. In order to meet this goal, metrics, associated models, and resulting decision support tools should ideally have the following seven characteristics:

- simple – they should be easy to use;
- easily obtainable – at a reasonable cost;
- precisely definable – it is clear how they can be evaluated;
- objective – two or more qualified observers should arrive at the same result;
- valid – they should measure, indicate, or predict correctly what they are intended to measure, indicate or predict;
- robust – relatively insensitive to changes in the domain of application;
- enhancement of understanding and prediction – good metrics, models and decision support tools should foster insight and assist in predicting process and product parameters.

The tools and techniques for supporting integration of environmental issues in product design can also be classified along the time and concern scales in Figure 2. In keeping with the different approaches mapped in Figure 2, in general there is a need for

- tools which assess/analyse different aspects of a product's life cycle (such as recyclability and remanufacturability assessments),
- tools which allow an assessment/analysis of the entire product's life cycle (for example, Life Cycle Analyses and Costing) are needed,
- tools which facilitate trade-off analyses in pursuing various life cycle aspects, i.e. decision support tools which include technical, economical, quality and environmental concerns.

It is important to keep the organizational aspects as well as (potential) time dependency of tools in mind. Designers at the part level (see Figure 3) have different requirements for a tool than designers/managers at the company level who interact with suppliers and sign off on whole products. The former need very specific tools, whereas the latter need broader, integrative tools. Furthermore, some tools can only be applied if the product's structure, materials and manufacturing processes are defined, at which stage it is typically very difficult to alter a design significantly if a reduction in environmental impact is needed. The type of product and business will also drive the need for tools. For example, a carpet manufacturer will not need a disassemblability assessment tool like a consumer electronic manufacturer. However, both will arguably need a Life Cycle Analysis tool.

Design guidelines and checklists

Design guidelines are among the most basic tools in design, and the introduction of appropriate design guidelines is one of the easiest ways to introduce environmental issues in design. A number of design guidelines, ranging from a focus on specific aspects of a product's life cycle (for example, "reduce the number of materials used to facilitate more efficient recycling") to sustainable development (for example, "reduce the use of non-renewable energy sources") have been developed in recent years. It would go beyond the scope of this article to list them all. Guidelines with respect to life cycle strategies are given in **Figure 5**. Guidelines can be augmented with checklists, where a designer marks whether he or she has considered the corresponding guideline. Combined with a short course or dedicated education session, guidelines and checklists provide an effective means of exposing designers to environmental issues and to ways to reduce the environmental impact of their products, especially when they are in line with enhancing other life cycle aspects. For example, the standardization and reduction of the number of fasteners used in a product facilitates not only recycling and remanufacture but also manufacturability – a key concern of many designers and companies. However, the greatest drawback of design guidelines is their qualitative nature, which hinders the assessment of trade-offs in particular.

Quantitative design assessments

Quantitative metrics are needed to assess progress and provide means for continuous improvement and feedback when integrating environmental issues in design. A variety of metrics have been proposed to allow comparison of designs, with most being based on some variant of life cycle assessment (LCA). In many cases, a full assessment of the entire environmental costs is not feasible given the work that would be required and the uncertainty in forecasting the changes in the economy and technology over the life of most products. Instead, the designers of these metrics attempt to achieve a balance between reducing the level of detail required and increasing the accuracy of the metric.

In many cases, assessment tools proposed for use in engineering design are based on Design for X methodologies. Most mechanical product designers are familiar with assemblability assessments. Methods for assessing other life cycle aspects such as serviceability and remanufacturability also exist, but are less well institutionalized. In general, these types of assessments fall under the realm of Design for X approaches.

In some cases, industry has taken the lead in defining assessment tools and metrics. For example, the North American automakers have developed a method for calculating vehicle recyclability as a percentage of weight based on two ratings for each component: a recyclability rating, ranging from 1 (best) to 6 (worst), and a material separation rating, ranging from 1 (best) to 5 (worst). It is likely that this assessment method will become a standard for the North American automotive industry.

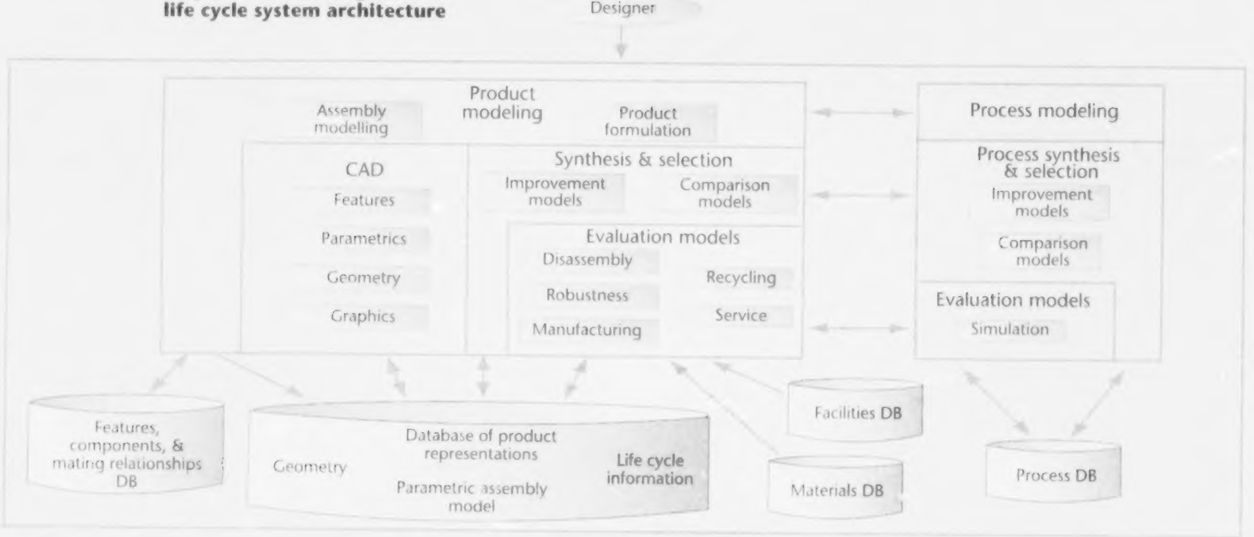
Relative vs. absolute design assessments

Even though the number as well as the maturity of different life cycle indices and indicators presented in the literature are rapidly increasing, they still suffer from the fact that a) a lot of data is missing, and b) weights and criteria are questionable because non-comparable units of measurement are used, thus leaving a lot of unanswered questions and room for political debate. Additionally, perceptions about environmental impact differ between countries. In Europe, a substantial amount of good research and development is done on Life Cycle Analyses/Assessment tools. However, the material databases developed for these analyses are not directly transferable from Europe to the US because of differences between European and US legislation and toxicity classifications. Nevertheless, many are still very suitable for use in design if one seeks to assess *relative* product improvements rather than absolute environmental impact.

As a nice representative example of a relative improvement assessment, consider the recently developed LiDS (Lifecycle Design Strategies) Wheel in Figure 5. The LiDS Wheel is part of the Dutch Promise Manual, an English translation of which is planned for publication by UNEP IE. The wheel asks companies to assess their current state with respect to eight life cycle strategies. Note that design guidelines are incorporated as part of the eight strategies in the wheel. Companies can map their current efforts in the spider diagram which highlights where their weak areas are. Once improvements have been made (or planned), a new assessment can be made and overlayed on the previous one, thus showing relative improvements. Note that no scales are defined. Also, there is no exact correlation between efforts and actual environmental impact. Yet the wheel visually conveys a company's relative effort and impact.

Simple assessment tools relieve small and medium-sized companies from spending resources on excessive education and/or high tech

Figure 6
Computer-based design for the life cycle system architecture



(computer) equipment. For example, the Promise Manual and the LiDS wheel have been explicitly targeted to such companies. Clearly, the level of sophistication needed is a function of organizational scope and capabilities.

Decision support tools

Tools for decision support and trade-off analyses are less well established. Many developments in this domain are concerned with the trade-off between environmental impact and financial costs/profits. When it comes to assigning costs to life cycle and ecological issues, Activity-Based Costing (ABC) is gaining ground rapidly on conventional costing systems. However, issues like the costs of using non-renewable vs. renewable resources are still unresolved. Design for assembly vs. disassembly is another area where trade-off issues are being investigated, primarily due to the importance of assemblability considerations in product realization.

When it comes to tools extending beyond a product life cycle and a single manufacturer, i.e. tools for supporting industrial ecology and sustainable development, few developments (with the exception of qualitative design guidelines) have been made so far. Decision support tools for industrial ecology will have to allow for the modelling and simulation of material input and output flows between various companies in order to assess the overall environmental impact of industrial ecosystems and the exploration of different scenarios for the formation and working of industrial ecosystems.

Integration into design practice and information management

Once the necessary tools have been defined, the integration of environmental issues and tools in the existing operating procedures of a product design group is still a significant challenge. This is primarily because the designers are often asked to do more in the same amount of time. Many case studies and experiences regarding the introduction of environmental concerns in a corporation can be found in the literature. Clearly, one should always consider the following:

◆ Who is supposed to use the tools, i.e. who is the audience?

◆ Why would they use them, i.e. what is their incentive?

With respect to the users, one should carefully plan by whom and where in the design process the tools should be used. For example, it does not make sense to have designers who work primarily with sheet metal do a recyclability improvement exercise because sheet metal is already easily recyclable. Also, the introduction of highly sophisticated computer tools (for example, a virtual product disassembly tool) does not make sense for a company without a well established computer infrastructure.

With respect to incentives, introducing new design guidelines and/or engineering standards dealing with environmental issues may not result in any increased effort unless a sign-off and/or check is required, thus sending a message to designers that they must comply with the new design requirements. For example, car manufacturers have introduced engineering guidelines for reducing substances of concern and increasing vehicle recyclability (such as General Motors' 1000-M and 502-M standards and Chrysler's CS 9003 standard) and require documentation from design engineers and suppliers, thus emphasizing the importance of compliance and providing an incentive. On the other hand, these companies also provide education and support services to designers and suppliers by specialized groups. And some OEMs reward suppliers financially for environmental excellence.

It should be noted that the simpler the assessment method, the more easily it will be accepted by designers in their current day-to-day activities. The author was once told by a high-level industry representative that "as long as it fits on one sheet of paper, designers will read and do it". Quite a challenge, but it does lower the acceptance threshold significantly. Other industry representatives are also starting to question how much more they can burden their design teams to do more in the same amount of time.

A key concern in introducing new tools into a design process is the gathering, management and leveraging of information required for environmental assessments. Although the number of tools available is rapidly increasing, many are stand-alone tools and very few allow sharing of information. A designer is often forced to re-enter the same data in different software packages, and not only for environmental assessments. Any company thinking about introducing new tools for environmentally conscious design should seriously consider the human and information factors involved. The objective should be to minimize the amount of information gathering and management as much as possible in order to increase the efficiency of designers, while at the same time increasing their scope of concern and effectiveness. One should therefore always try to integrate new tools into existing and accepted design systems. However, this may lead to the insight that research and development in new systems is appropriate. For example, one can argue that conventional CAD systems are not the most efficient support for a more integrated approach to life cycle design due to their heavy focus on geometric information management. New computer-based design systems will have to be developed to fully support environmentally conscious design. As a representative example of such development of new systems, consider the next generation computer-based design system architecture presented in **Figure 6**, which is under development in our Georgia Tech System Realization Laboratory. Its purpose is to support Design for the Life Cycle.

As can be seen in Figure 6, it contains both product and process design modules. Included in the product design module are synthesis, selection and evaluation modules. The objective is to increase the efficiency and effectiveness of the designer, among others by reducing the duplication of information entry and by leveraging information for a greater variety of assessments. The system in the figure is representative of the types of design systems that are needed to support integration of environmental issues in modern product design.

Education: a necessary prerequisite to all of the above

Technology cannot solve all problems. Perhaps the most important issue in moving towards integrating environmental issues in product design is education. For example, in the US a large number of graduating mechanical engineers (still) do not know that Toxics Release Inventories and pollution prevention programmes are required by law for generators of hazardous materials, and that failure to comply may result in criminal prosecution. Many European technical universities nowadays require their engineering students to take a class on Environmentally Conscious Design and Manufacture. Although a large number of US universities claim to work on environmental issues, only a few have formal courses in place. This is changing rapidly, and the opportunity to create an impact through education is enormous. As an example, consider the author's institution, the Georgia Institute of Technology, which has the largest College of Engineering in the US. Its School of Mechanical Engineering alone graduates yearly 2 per cent of all the mechanical engineers in the US. Five years ago, with the exception of civil and environmental engineering, no engineering student was exposed to environmental issues in his or her discipline. Now, lectures on environmental issues are integrated in various engineering design and manufacturing classes and students can also take specialized classes in Environmentally Conscious Design and Manufacture as well as Sustainable Development. Large companies have also stepped up education for their workforce and suppliers. For example, GM, Ford and Chrysler all provide design for recycling and design for environment training courses for their employees and suppliers.

Related to education is the dissemination of information. Much information regarding environmental issues is available from, say, chemical engineering, but where would a mechanical engineer working in a small company retrieve relevant information? Interestingly, the rapid development of the Internet has opened new and faster avenues for information dissemination. Many organizations publish relevant information for free on the World Wide Web, ranging from Material Safety Data Sheets to actual case studies and tool demos.

Closure

In this article, a number of options and issues are discussed which companies and organizations should consider when pursuing integration of environmental issues in product design and realization. Clearly, a wide variety of approaches for reducing the environmental impact exists, as well as supporting tools. It is imperative that a company recognizes its current state and capabilities, as well as its motivation and target level for integrating environmental issues in product design and realization. Furthermore, a unilateral decision may have deep consequences in today's highly integrated product realization practices. Nevertheless, in the US the following trends can be seen in industry:

On the positive side, large US companies with global markets are paying close attention to progressive European (and other) initiatives and legislation. In particular, the car companies (GM, Ford and Chrysler), the electronics companies (for example, those organized in the Microelectronics and Computer Technology Corporation – MCC), and large worldwide chemical companies and material suppliers (for example, those organized in the American Plastic Council) are active and even extremely pro-active in some cases.

On the negative side, small to medium-sized companies with domestic markets often worry only about satisfying local, state and federal (EPA) regulations (if at all). Many small companies and/or Small Quantity Generators (i.e. those with less than a 1000 kilograms of hazardous waste per month) have no clue about pollution prevention, let alone about DFE, industrial ecology, or even sustainable development.

With respect to small and medium-sized companies, however, we are seeing a domino effect due to the fact that large Original Equipment Manufacturers are starting to force their first-tier suppliers to comply with their proactive measures and foreign mandates as well. These suppliers are starting to pressure their suppliers, etc. In the near future, ISO 14000 may cause an even deeper ripple effect, augmented by increased awareness through education.

It is the author's experience that, invariably, everybody buys into the philosophy of environmentally conscious design, industrial ecology, and sustainable development. The challenge lies in its seamless implementation in existing and new practices. Many corporations, designers and engineers agree that the issue is not *whether* they should become environmentally responsible in product design and realization, but *when* and *how*.

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Sustainable Product Development: opportunities for developing countries

Hans van Weenen, Director, UNEP Working Group on Sustainable Product Development, International Centre, University of Amsterdam, Nieuwe Achtergracht 166, 1018 WV Amsterdam, the Netherlands

Abstract

Sustainable Product Development (SPD) can be defined as resource-, context- and future-oriented product development, aimed at providing elementary needs, a better quality of life, equity and environmental harmony. It goes beyond ecodesign, which usually focuses on the environmental optimization of existing products. SPD is concerned with changing patterns of production and consumption. A great deal of local knowledge on renewable resources is available in developing countries. Local knowledge from the South can be merged or reformulated with, and stimulated by, scientific knowledge from the North, and vice versa.

Résumé

Le développement de produits durables peut être défini comme une approche de développement prenant en compte les ressources, le contexte et l'avenir, avec pour objectif de satisfaire les besoins élémentaires des hommes et d'assurer une meilleure qualité de vie, l'équité pour tous et l'harmonie avec l'environnement. Il va plus loin que l'écodesign, généralement axé sur l'optimisation écologique des produits existants. Le développement de produits durables a pour objet de modifier les modes de production et de consommation. Les pays en voie de développement possèdent à l'échelle locale une masse importante de connaissances sur les ressources renouvelables. Ces connaissances du Sud pourraient être fusionnées ou reformulées avec les connaissances scientifiques du Nord, voire stimulées par elles, et inversement.

Resumen

El Desarrollo sostenible de Producto (SPD) puede definirse como un recurso-, contexto-, y desarrollo de producto orientado hacia el futuro, con el fin de proporcionar las necesidades elementales, una mejor calidad de vida, equidad y armonía en el medio ambiente. Va más allá del diseño ecológico, que se centra generalmente en la optimización medioambiental de los productos existentes. SPD trata de la evolución de los modelos en materia de producción y consumo. Localmente, existe una cantidad considerable de conocimiento respecto a los recursos que se renuevan en los paises en vías de desarrollo. El conocimiento local del Sur puede fusionarse o modificarse con, y estimularse mediante, el conocimiento científico del Norte y vice versa.

Introduction

In this century the human influence on the environment, and on the survival of humankind, has become manifest. As a result, in Europe a change of direction is taking place in which more consideration is being given to the environment. However, rather than a slight and temporary change of direction, a fundamental change of course towards sustainability is required.

What will not be sufficient in itself is the current focus in Europe on reuse and recycling and the striving for a "closed loop" waste policy in order to realize an "eco-cyclic society". The character of the material throughput in industrialized society, the design of resource cycles, and the diversity of cultures should also be addressed. Choices must be made that give more attention to values, elementary human needs, resource properties, required product and service functions, and local conditions.

Europe has a moral obligation to become the cradle of a new sustainable global civilization, for which new strategies must be formulated and implemented. Sustainable Product Development (SPD) places a strong emphasis on the future of developing countries. This year, five years after UNCED in 1992, achievements are being critically assessed. Co-development, in cooperation with developing countries, offers the possibility of a challenging journey of discovery.

Sustainable Product Development (SPD)

Beyond ecodesign

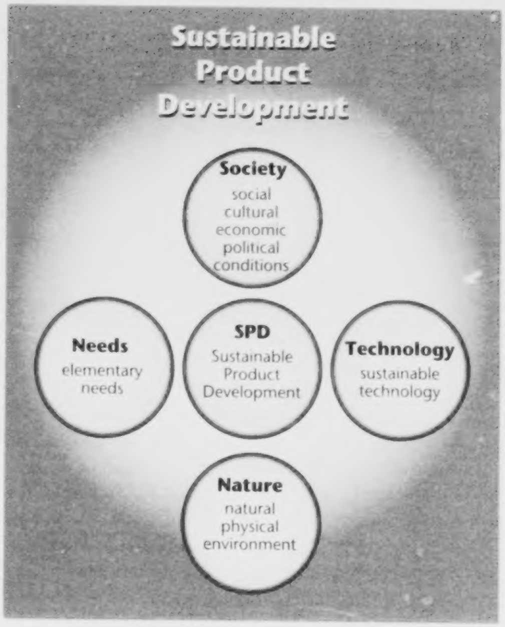
When municipal waste treatment problems occurred in the industrialized world, they were mainly dealt with by the introduction of separate collection schemes for recyclable waste and hazardous waste, or so-called "problem products". In some cases, product composition was changed to eliminate a specific pollutant (e.g. heavy metals or chlorinated solvents). This could be called "Design for Pollution Prevention". In other cases, material recycling problems were reduced by changing product design (e.g. less complex laminates in packaging, less diversity in plastic materials). This could be called "Design for Recycling". Later on, more systematic approaches were taken according to which, for example, new packaging concepts were introduced, such as multi-use containers. This could be called "Design for Reuse". The disassembly of some complex products was improved, leading to better treatment, recycling or reuse of specific materials or components. This could be called "Design for Disassembly".

These design approaches mainly focus on the waste disposal stage. They represent the first level of ecodesign. Thus, they are characteristic of the end-of-pipe or end-of-product-life emphasis that still dominates environmental policies in much of the world. Fortunately, increasing numbers of researchers, policymakers, industrialists and activists are discovering the improvement potential of a focus on the product life cycle, the beginning of the pipe, and especially the front end of product life. Reorientation is already taking place. The once popular waste policy objective of going "back to the source" is becoming a popular product and industry policy of going "back to the resource", whereas interest in "material values" is shifting towards "human values".

An important change in perspective is to consider products as material objects that have a history as well as a future. The product of today will be the waste product of tomorrow. Products have a life, from resource extraction to product disposal. Their life cycle consists of various transformation stages, beginning and ending with the environment. Materials are taken from and returned to the environment. At each stage, energy and material changes occur which lead to waste and emissions that influence the quality of the environment. Currently, in "ecodesign" or "design for the environment" (DFE), the objective is to reduce the environmental impact at every stage of the product's life cycle. This can be considered the second level of ecodesign: environmental optimization of a product throughout its life cycle. However, very few products which have emerged from ecodesign initiatives can be considered examples of systematic ecodesign, in which the entire life cycle is taken into consideration. Even fewer examples exist of the more advanced third level of ecodesign, in which a product's function is considered and discussed, including alternative, more sustainable ways of providing it. Examples are the replacement of a product with a service, or questioning whether a product is really needed in the first place. In this case a theoretical framework might exist, but practical implementation is still rather scarce.

The SPD concept

Sustainable Product Development (SPD), the fourth and most demanding level of ecodesign, goes well beyond environmental optimization of products, which is currently usually the central objective of ecodesign. SPD addresses values and focuses on elementary future needs, especially those of people in developing countries. SPD focuses on the functions to be delivered through products, systems and services. It considers the properties and availability of resources and their distribution among countries and generations in the past, present and future. It is embedded in, respects, and builds upon the context of local physical, natural, social, cultural and economic conditions. These may be enriched on the basis of an input of sustainable principles, concepts and resources from elsewhere.



Indigenous knowledge and skills are central to SPD implementation. On the one hand, SPD is oriented locally and can merge local traditional solutions with components of international industrial technology. On the other hand, it has a global orientation. It considers the various regional physical and ecological conditions that strongly influence the availability, quantity and quality of resources and energy. SPD can be considered a qualitative rather than a quantitative concept.

The starting point of SPD is that the material input and throughput level of the industrialized world, or elite, must be strongly reduced and that the general character of resource usage must be changed. This change must be away from fossil fuel and non-renewable resource usage and towards sustainable usage of renewable resources, including water, air and solar energy, in all their diversity. It should facilitate taking full advantage of the intrinsic properties of resources. However, only the combination of material input and throughput reduction with fundamental input redirection can serve as a basis for sustainable product development.

The product development process as such, which has been developed by industrialized countries based on values and principles that are not sustainable, will be challenged. Instead, participatory product development is envisioned. It can serve as a basis and be expanded with principles, ideas, concepts and examples from elsewhere if attractive. The very basis of the SPD process is the formulation of values and needs, and of functions and solutions, preferably by the people concerned or with their active participation.

The concept of Sustainable Product Development integrates the aspects of society, needs, technology, and natural-physical conditions. It also addresses the origin and design of products which can be either "Northern" or "indigenous" or combinations of these. It will stimulate programmes for using "indigenous" knowledge in the area of modern science as well as using "modern" science in that of traditional knowledge. This is all considered from a perspective of equity, reciprocity and co-development.

Thus, Sustainable Product Development (SPD) is defined as resource-, context- and future-oriented product development, aimed at the fulfilment of elementary needs, better quality of life, equity, and environmental harmony.

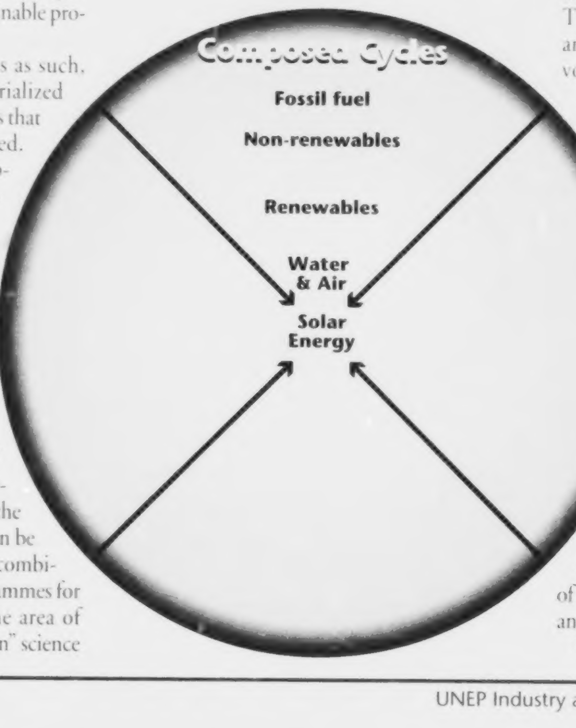
Resource cycles

Closing cycles

Reformulation of the material input and throughput of industrialized society is central to the envisioned transition towards sustainability. It is what changing production and consumption patterns is all about. There are already signs in industrialized countries of a changing appreciation of the predominant linear material metabolism of society. Several European countries have decided to establish a more cyclical metabolism, through the introduction of recycling and reuse schemes and the presentation of concepts such as the closed-loop economy and the "eco-cyclic" society (Denmark, France, Germany, the Netherlands, Sweden).

However, just closing loops and creating cycles for waste materials will not be sufficient. First of all, such actions have environmental implications of their own. To bring them about, usually additional input of materials and energy will be required, although of course primary resource use may be reduced. Secondly, they do not necessarily (mostly they do not) address the very nature of the waste generation process itself. Often neither the chemical composition of consumer products that become waste, nor their recycling properties, are considered, let alone the level and pace of their production and consumption. The emphasis in the countries currently oriented towards recycling is rather on selective collection and treatment of waste than on the origin of the waste products involved and possible measures to be taken in that regard.

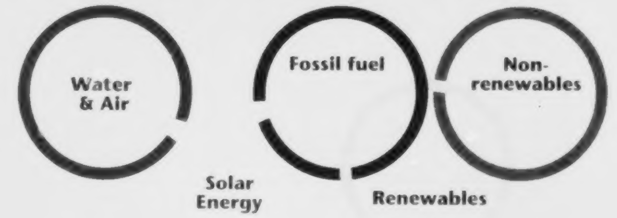
A promising shift in emphasis is the introduction of producer responsibility for the environmental life cycle implications of a product, which can lead to increasing attention being given to product development as a point of action. Just creating cycles for the sole purpose of recycling is the expression of a very limited vision indeed. Although "material cycling" and the "eco-cyclic society" (of Sweden) could be beneficial, it is essential to consider the precise character of the cycle to be formed. This means that the existing throughput should first be critically evaluated.



Resource cycles

The characteristics of an overall materials cycle are, for example, the cycling rate, the mass and volume of the materials concerned, and the various elementary types of resource cycles that should be distinguished. In addition, the diversity and proliferation of fossil fuel-based synthetic chemical substances, the cascading of resources, and compatibility with nature must be considered. Clearly, closing the loop only for the sake of closing it would in fact be just another end-of-pipe approach, in this case directed to the end of the pipe of the material metabolism of society. It would just follow the panacea of waste reuse as the remedy for all waste problems. It would not take notice of the nature and extent of production and consumption, or the character of resource usage, as some of the basic causes of the generation of waste and emissions. Cleaner production for the throughput process of society involves closing the loop and reducing and changing the input, among others.

Unfortunately, people frequently fail to make


Acknowledgement of Resource Cycles

the direct connection between waste and emission problems on the one hand and the level of resource use and energy use in production and consumption on the other. As in the industrialized world, when resources are readily available at relatively low prices, wastes and emissions will correspondingly be easily produced. A reorientation of the materials cycle of the industrialized society could, however, alter this perspective drastically. By focusing on the input, nature, availability, quality and intrinsic properties of resources, and by incorporating the dimension of sustainability, fascinating new challenges emerge.

Resource cycles that can be distinguished concern: a solar energy cycle, a water and air cycle, a cycle for renewable resources, a cycle for non-renewable resources, and a fossil resources cycle. This division then goes beyond the general distinction that could already be made between the "mineral cycle" (geosphere) and the "bio-cycle" (biosphere).

The development of specific resource cycles, and the characteristic process and product development based on and connected to those cycles, could be called "Resource Cycles Development". This new concept will be attractive to academia, industry and NGOs, as well as government and politicians, because it offers new challenges and potentially attractive solutions to some natural resource-related environmental problems. Jointly they can chart and realize the new sustainable societal materials cycle. For developing countries, resource cycles of particular interest are the water cycle, the cycle for renewable resources, and the solar energy cycle. Below, with a focus on developing countries, aspects of sustainable use of renewable resources for material purposes will be addressed.

Development potential

From within

A shift away from fossil fuel and from non-renewable resources would lead to increased production, use and trade of materials and products based on renewable resources. This could lead to the realization of a more sustainable industry, and it could contribute to the development of low-income countries and to poverty alleviation. For developing countries, Mehmet Arda of UNCTAD sees opportunities for the competitiveness of "natural products with environmental advantages". He distinguishes:

◆ products with relatively large and established markets, such as reusable and recycled materials/products, biomass fuels, and organically grown products (both food and agricultural fibres such as cotton);

◆ products with considerable potential but rudimentary markets, such as agricultural fibres, alternative wood sources (rubber and coconut trees), and wood substitutes (agricultural crops and agricultural wastes);

◆ niche products, e.g. some non-food forest products used as food (such as fruits and nuts), industrial inputs (such as bamboo and rattan), and health care ingredients.

Whereas these ideas of Arda are mainly presented within the framework of traditional international trade, Prof. Dr. Hamed El-Mously (see article in this issue) takes a different approach. He suggests that developing countries may evolve their own authentic response to the environmental crisis by beginning with their own traditions and formulating their own forms of modernity.

A similar approach can be found in the programme of the Inter-Regional Volunteer Programme for Artisan Support (IVPAS) in Noida, India, the objective of which is to catalyze an international volunteer movement for the promotion of a sustainable model of development that is artisan-led. The programme emphasizes the social, economic and environmental advantages of artisanal production and distribution systems. For that purpose, linkages and networks are formed between existing national and sub-regional artisan networks and communities through sharing and exchanging information.

Indigenous knowledge

The potential value and possibilities of application that local indigenous knowledge has for sustainable development are also recognized and promoted by the international Indigenous Knowledge network. They are summarized as follows:

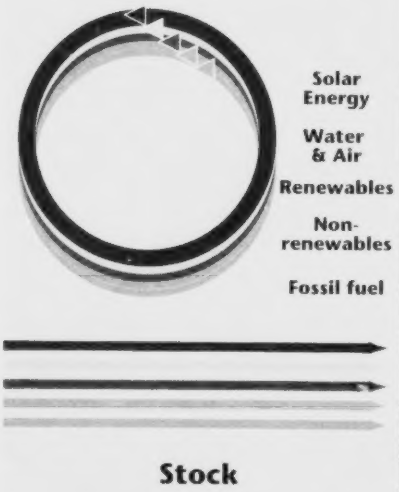
◆ Indigenous knowledge of resource management provides a valuable information base which could be used in the management of natural resources for sustainable development.

◆ Use of indigenous knowledge in the planning of development projects generally facilitates the participation of the beneficiaries.

◆ The knowledge developed by communities over centuries can be integrated with modern scientific knowledge in order to create appropriate technologies leading to sustainable development.

◆ Indigenous knowledge can facilitate communication by providing a better understanding of how people perceive their environment and develop their perceptions.

Cyclic Compass



These approaches provide an alternative to the globalization and homogenization of industrial development and its products, systems and services. Not only do they acknowledge and value local knowledge, but they are also aimed at exploring, reporting and conserving the local treasure of experience, practice, examples and ideas. The importance of biodiversity for the global community has been well recognized internationally. However, the fact that cultural and knowledge diversity is as important for the prospects of a sustainable future is being overshadowed by the Northern endeavour to achieve economic globalization.

Modernity

SPD examples

The objective of the UNEP Working Group on Sustainable Product Development (UNEP-WG-SPD) is to develop and to promote SPD through research and network activities, advice, information, and education. The Working Group promotes the development of products, systems and services that meet human needs in an equitable and environmentally responsible way. The aim is to communicate the SPD message worldwide. Already the UNEP-WG-SPD Network has an active global membership of over 650 organizations in 55 developing and developed countries. SPD examples are collected via this network, from literature and through Internet. These examples serve as a bridge between theory development and practical implementation. Based on the knowledge of the SPD concept, examples are selected. Through analysis and discussion of examples, the understanding of SPD is further improved. At the same time, pioneers and innovators, particularly within SMEs, can be exposed, can receive valuable information, can make new international contacts, and may find support for their ideas. Thus, practical implementation and local or regional sustainable industrial development can be stimulated.

With support from the Austrian Ministry for

Some results of a sustainable development approach: products from and for developing countries

The Freeplay clockwork radio

The BayGen Freeplay radio is a battery-less clockwork radio designed by Trevor Bayliss. It was developed by Mr Bayliss after he watched a television programme about the spread of Aids in Africa in which the World Health Organization said that the biggest problem in spreading reliable health information was that so few people could afford batteries. In developing countries these can be difficult to find and prohibitively expensive. The clockwork radio was developed as a communications tool for developing countries, filling the gap for a cheap, simple-to-use and easy-to-maintain information source that is not reliant on batteries or external electricity supply.

The radio is powered by winding a fold-away handle: 60 turns of the handle provide power for around 40 minutes of listening. The spring life is estimated to be between 6600 and 20,000 hours

The radio is an appropriate technological solution for countries where affordable energy is scarce or totally unavailable. Other applications are being developed, including a spring-powered torch.

© Baygen Power, Europe

The bamboo bicycle

The bamboo bicycle, which is still in the development stages, is an exclusive design from Antoine Fritsch for the French luxury goods firm, Hermès. The bicycle frame is made from block-dyed black chrome and hand-shaped, tied bamboo. The bamboo frame is reinforced with wood for stability and carbon fibre is used to provide rigid frame joints. The handlebar grips are made from cork, the wheel rims from beech wood, and the seat from leather. The three gears, controlled from the handlebars, are integrated into the wheel hub, and the bicycle has drum brakes.

One of the major advantages of bamboo is that it is that it provides a rapidly renewable and widely available source of a natural tubular material with high strength to weight ratio. The bamboo bicycle illustrates how bamboo can be used to make strong structural frame members. The material can have similar applications in scaffolding or bridge building.

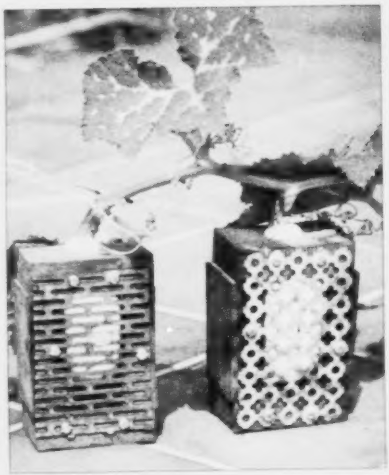
© Hermès, Paris

The Fleming hydro-ram water pump

Hydro ram pumps make use of the energy from flowing water to pump water uphill. They can be used wherever there is a minimum water "drop" height above the pump of just over half a metre. Hydro rams can raise water by as much as ten times the head height. This means that water can be raised over ten metres with a head height of only one metre. Fleming hydro ram pumps are used throughout the world to provide water to homesteads and to water animals, gardens, farms and orchards, or for drip feed crop irrigation. The pumps have only two water-lubricated moving parts, making them virtually maintenance free and ensuring long service life. Fleming hydro ram pumps can be licensed for production in host countries.

©The Ram Company, Lowesville

Gourd packaging



Most cosmetic products are packaged in glass or plastic containers, which are often difficult to reuse or recycle. The gourd, which has traditionally been used as a bottle, can be grown in a mould to alter its shape and so adapt it to modern uses and forms of transport. Gourds grown in this way are suitable for storing cosmetic products such as bath oils, bath salts and powdered soaps, and similar products. Once dried, the sides of the fruit become woody and watertight. Further waterproofing can be obtained through treatment with wax or oil and the container can be painted. Product information texts and logos or other designs can also be incorporated into the mould.

The gourd is an annual crop which can be grown outdoors, so there are no heating costs. The gourd seeds contain oil which could be used in the production of cosmetics, and even the leaves and stems could be put to use. The bottles are biodegradable.

© Jan Velthuizen, Utrecht

The UNEP-WG-SPD International Centre welcomes examples of sustainable product design from anywhere in the world. The elementary needs on which the Centre focuses are water, cooking, clothing, heating, communications and transport. The Centre is interested in design approaches involving renewable materials, renewable energy, dematerialization, life cycle design, longevity, services and optimized design. Examples of products such as the ones above are available on Internet at http://unep.frw.uva.nl/.

Environment, Youth and Family and the Austrian Ministry of Science, Research and Culture, the UNEP-WG-SPD has selected and described 35 SPD examples. To illustrate this article, four examples are described.

Exchange rather than transfer

In August 1996, two members of the UNEP-WG-SPD staff visited Benin to explore Sustainable Product Development. They learned that much knowledge exists about nature, e.g. trees, plants and leaves, and also clay and the use of biofuels. A very sophisticated system exists in Benin, central to which is the use of leaves for the packaging of food. At least ten different types of leaf are used for this purpose, some of which have a flavour of their own. The knowledge of leaf packaging is not reported, so that many more leaves may be used for packaging or other purposes. Moreover, such knowledge may be known in one region of the country but not in another. However, the knowledge concerned is not acknowledged as important and, gradually, plastic bags are being introduced into the market. All kinds of environmental problems are associated with these bags, problems which are new to Benin and very difficult to deal with.

It was found that pottery making was quite diverse and included the production of pots for cooling water. But, in the production of clay roof tiles, making them watertight was a serious problem. It seemed that knowledge from one discipline (pottery making) was not transferred to another (tile making). Another observation was that a variety of biofuels were used for diverse wood stoves. It was not clear which type of clay-manufactured wood stove could best be used with which type of biofuel. Again, much local knowledge exists concerning the making of all kinds of clay products, but there is great potential for further improvement of their efficiency, use and dissemination. Opportunities also exist for cooperation between artisans and producers from various parts of the country with different knowledge, experience and skills. These observations put the international initiatives of transfer of environmentally sound technologies in a different perspective. Clearly, much transfer could be realized within the country, and within and among technical disciplines.

Building upon that, knowledge from other countries in West Africa, or from other Southern countries, could be used in Benin to improve the products, systems and services concerned. Principles, ideas and technologies from the North could be merged or combined with those of the South to further improve development prospects. And, most certainly, the North can learn a lot from local knowledge in the South. Therefore, "transfer" is an inappropriate term. The term "exchange" is better, as it expresses a two-way direction of knowledge. The best term, however, would be "co-development", as the quest for sustainability is as important to the North as it is to the South.

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The rediscovery of local raw materials: new opportunities for developing countries

Hamed El-Mously, Director, Centre for Development of Small-Scale Industries, 1 El-Sarayat Str., Abbassiah, Cairo, Egypt

Introduction

The cultures of the world emerged and evolved using different raw materials. In the rural areas of developing countries, people have developed symbiotic relations with their indigenous resources. Within the framework of subsistence economies, local innovation has been a necessity. Thus traditions of rational use of local raw materials have been the backbone of life at the local community level.

Pruning of date palms

Many developing countries have managed to imitate the patterns of consumption and production prevailing in the industrialized countries. It is not just a world of commodities and techniques they may adopt, but a whole alien system of paradigms associated with these patterns. As a consequence, many local raw materials tend to become redundant and to be neglected. This leads to the loss of a very rich heritage of knowledge and skills related to the use and processing of these materials. Poverty in many developing countries can be attributed to lack of participation, and poverty of thought and imagination, with respect to indigenous raw materials rather than to the lack of any production factors in the direct economic sense. Meanwhile, many developing countries are simply unaware of the drastic shifts occurring in many industrialized countries, especially in Europe, as a response to the environmental crisis, especially since the UN Conference on Environment and Development in Rio de Janeiro in 1992.

The environmental challenge

"Agenda 21" of the Rio de Janeiro Conference calls for changes in production and consumption patterns in order to ensure a sustainable future. This represents a new challenge for the developing countries, especially those which haven't gone too far in building their infrastructures and developing their industries. Instead of perceiving contemporaneity as merely the imitation of industrialized countries, developing countries have to work on their own formula of sustainable development. They have to develop their own means of building up endogenous capabilities within the framework of sustainability. They have to learn to be more selective in their adoption of consumption and production patterns from the industrialized countries. And they have to rely more on themselves and learn to build on their own traditions. This will motivate them to develop their own conception of sustainable development and coin their own form of modernity.

The rediscovery of local raw materials

Many local raw materials in developing countries are "captured" within certain narrow uses associated with a traditional, dominantly rural way of life. The study of these materials' traditional uses could be very useful in order to learn more about their physical and mechanical properties. However, these materials are often produced and/or consumed only in certain social strata. For example, uses of agricultural residues in developing countries are usually associated with the poor in rural areas, whether as producers or consumers. Thus the value of these resources, already limited, tends to decrease with changes in the way of life. This leads to the neglect of these resources and the collapse of the primary economic activity producing them (for example, agriculture or mining), leading in turn to the marginalization of whole regions, especially in terms of their rural areas, poverty, and the collapse of the local community, which is a socio-cultural/ecological subsystem in its own right. What is needed is a new perception of local raw materials in a context much wider than the traditional subsistence-oriented one. This means:

a) increasing consumption to include higher (medium and upper) classes locally and abroad; this includes the design of new products to satisfy the requirements of new markets;

b) introducing more advanced technologies with the objective of improving product quality, increasing productivity, introducing new product characteristics or functions, and developing new technologies for totally new lines of products; this could be carried out along the continuum of handicrafts/mechanical industries/chemical industries;

c) rationalizing the use of resources environmentally, as far as possible, and trying whenever feasible to substitute non-renewable by renewable resources; this includes efforts in regard to both the design of new products and the development of new technologies.

Thus, what is called "the rediscovery of local raw materials" means imagining, thinking, designing, carrying out research and producing prototypes, conducting market research, etc. in a very interactive fashion as shown in **Figure 1**, with the objective of developing new uses of local raw materials. Returning to the local community level, this means the creation of a new form of sustainability and the transition from subsistence to market economies and from the traditional to an authentic form of modernity for the local community.

New opportunities for the developing countries

The trend towards rediscovering local raw materials provides many developing countries with a very strong stimulus for building or rebuilding their endogenous scientific and technological capabilities within a new vision of sustainable development. Moreover, this trend opens new opportunities for trade between developing and industrialized countries. There are now consulting and research companies in Europe which are commissioned to inform exporters from the developing countries about opportunities in their

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Figure 1
Different activities, related to the concept of rediscovery of local raw materials

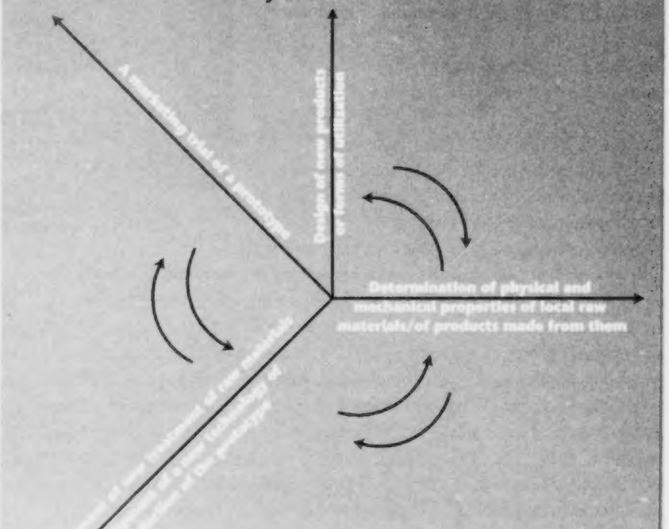
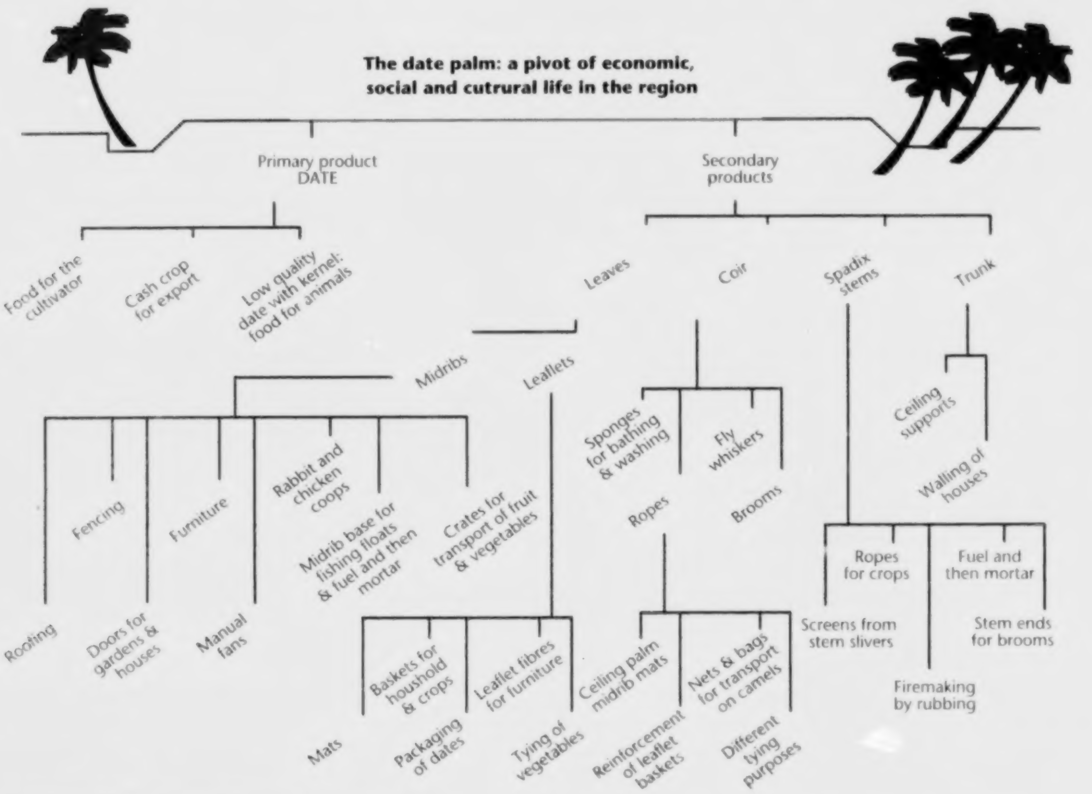
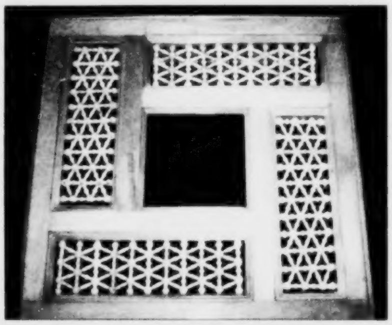

A marketing trial of a prototype
Design of new products or forms of utilization
Determination of physical and mechanical properties of local raw materials/of products made from them
Development of new treatment of raw materials
Development of a new technology of production of the prototype

Figure 2
Uses of palm secondary products: an eloquent example of local innovation


The date palm: a pivot of economic, social and cutrural life in the region
Primary product DATE
Food for the cultivator
Cash crop for export
Low quality date with kernel: food for animals
Secondary products
Leaves
Coir
Spadix stems
Trunk
Midribs
Leaflets
Roofing
Fencing
Doors for gardens & houses
Furniture
Manual fans
Rabbit and chicken coops
Midrib base for fishing floats & fuel and then mortar
Crates for transport of fruit & vegetables
Mats
Baskets for houshold & crops
Packaging of dates
Leaflet fibres for furniture
Tying of vegetables
Sponges for bathing & washing
Fly whiskers
Ropes
Brooms
Ceiling palm midrib mats
Reinforcement of leaflet baskets
Nets & bags for transport on camels
Different tying purposes
Ceiling supports
Walling of houses
Screens from stem slivers
Ropes for crops
Firemaking by rubbing
Fuel and then mortar
Stem ends for brooms

Source: El Mously, Conference: Challenges of Sustainable Development, Amsterdam, August 1996

European export markets resulting from new environmental policies in the European Union. A general preferential system is being worked out. According to this system, preference could be given to products from developing countries which are produced in a more environmentally friendly way.



Furniture with arabesque pattern made from DPLM

The date palm leaves' midribs: a new industrial raw material

The date palm is one of the most important plants not only in Egypt, but in the whole Arab World. Until perhaps the beginning of the 20th century, the date palm was essential to the economic life of the whole region. Besides dates, it provides several secondary products: date palm leaves' midribs (DPLM), leaflets, coir, spandix stems, kernel and trunk. **Figure 2** shows the importance of innovation, within a subsistence economy, in using these products to satisfy many basic needs. DPLM is produced from the annual pruning of palms. The crop amounts to 136,000 tonnes and 1.8 million tonnes a year in Egypt and in the whole region, respectively. Traditionally, DPLM was mainly used for ceilings and fencing in rural areas, as well as for crates used to transport vegetables. With changes in the way of life in Egypt and the region, these uses diminished, leading to the neglect of pruning and a decrease in the economic feasibility of palm cultivation. In addition, when pruning did occur, the DPLM crop turned out to be a burden on the environment.

Research conducted since 1990 by the Centre for Development of Small-scale Industries, Egypt, shows that DPLM has physical and mechanical properties that can compete with those of several imported wood species, such as spruce and beech. This is especially significant in that Egypt has very limited forest resources. Therefore, development activities have been directed to final product lines in which DPLM could be used as a substitute for imported wood. The following product lines are included:

a) mashrabiah products (arabesque), as a substitute for beech;
b) blockboard, as a substitute for spruce wood in the core layer;
c) particle board, as a substitute for casuarina;
d) lumber-like products, as a substitute for several types of wood such as red pine and spruce.

Conclusion

The example of date palm leaves' midribs eloquently demonstrates that an agricultural waste can be turned into a value-added product. I am sure that tens of the elements of flora and fauna, as well as mineral resources (renewable, like shells, or non-renewable) in developing countries are neglected, misused or irrationally used. They await the power of imagination and thinking, as well as the will to change reality, to introduce new product lines and create new markets for them, locally and abroad, taking the environmental dimension into account. This represents a new challenge to the intelligentsia in the developing countries. They do not have to choose between their traditions and modernity, in the form of ready-made commodities presented in a shop window. They have instead to build their own form of modernity through dialogue, both with their traditions and with the contemporary world. The rediscovery of local raw materials could have an important role in this process.

Dynamics in ecodesign practice

Han Brezet[1], Professor, Section for Environmental Product Development, Faculty of Industrial Design Engineering, Delft University of Technology, Jaffalaan 9, 2628 BX, Delft, the Netherlands

Abstract

Ecodesign is a promising approach to sustainable production and consumption. Four different types of ecodesign innovations are distinguished. Product improvements and redesign (types 1 and 2) can realize eco-efficiency improvements of up to 80 per cent (a factor of 5). To achieve the breakthrough to sustainability, however, product function and system innovations (types 3 and 4) will be needed. It is recommended that implementation of these concepts be promoted through extensive demonstration programmes and activities by national-level organisms. Government actions in support of ecodesign innovations in the near future are badly needed.

Résumé

L'écodesign est une approche de la production et de la consommation durables qui ouvre de nombreuses perspectives. On peut distinguer dans ce domaine quatre types d'innovations : les améliorations et les transformations de produits (types 1 et 2) permettent d'accroître l'éco-efficacité, parfois de 80 % (soit un facteur de 5) ; mais pour parvenir à la viabilité écologique, des innovations au niveau des fonctions et des ensembles de produits (types 3 et 4) sont nécessaires. Pour cela, il faut que des organismes d'envergure nationale mettent en place de vastes programmes et activités de démonstration destinés à promouvoir l'application de ces principes. Il est urgent que les gouvernements prennent rapidement des mesures pour soutenir les innovations dans le domaine de l'écodesign.

Resumen

EL diseño ecológico constituye un enfoque prometedor para la producción y el consumo sostenibles. En este campo, se observan cuatro tipos diferentes de innovación. Mejoramientos y rediseño de productos (tipos 1 y 2) pueden lograr una eficiencia ecológica hasta del 80 por ciento (un factor de 5). Para alcanzar la sostenibilidad, se necesitarán sin embargo innovaciones en las funciones de los productos y en los sistemas (tipos 3 y 4). Se recomienda promover la aplicación de dichos conceptos mediante programas de demostración masivos y actividades desempeñadas por organismos a nivel nacional. En el futuro próximo se necesitará en gran medida la acción de los Gobiernos en apoyo de las innovaciones en materia de diseño ecológico.

Introduction

More and more societal driving factors, such as product take-back obligations, consumer organizations' tests, and product end-of-life costs, are forcing industries to take a critical look at their products and to include environmental considerations in the product design process. Governments play an important role in fostering this industrial change, not only through negative sanctions using product-relevant legislation, but also through positive stimuli, for instance with the support of industrial experiments. Demonstration programmes, research and development funds, and training all help companies develop new knowledge of environment-oriented product design, or ecodesign.

An example of such a positive stimulus is the recent publication, *Ecodesign: A promising approach* (UNEP IE, 1997). In this publication ecodesign is described as a concept in which "the environment" helps define the direction of product design decisions. In other words, the environment becomes a co-pilot in product development. In this process of ecodesign, the environment is given the same status as more traditional industrial values such as profit, functionality, aesthetics, ergonomics, image, and overall quality. In some cases the environment can even enhance traditional business values.

In the UNEP ecodesign manual, the word *ecodesign* has been chosen as the basic concept since it implies that there is a need to balance ecological and economic requirements while developing products. Ecodesign considers environmental aspects at all stages of the product development process, striving for products which make the lowest possible environmental impact throughout the product life cycle. In the end, ecodesign should lead to a more sustainable product life cycle and system of production and consumption. In making this approach operational, the manual particularly focuses on the methods used for, and gives international examples of, the (eco-)redesign of existing products. This practical approach is generally the appropriate way for companies, designers and consultants worldwide to become acquainted with ecodesign in practice. Now, however, the ecodesign concept is also, in *innovative* industries, broadening its content beyond redesign.

Based upon an analysis of experiences with ecodesign in industrial practice since 1990, four types of product-related environmental (ecodesign) innovations can be distinguished, as shown in **Figure 1**. This figure gives an overview of different types of ecodesign innovation, related to eco-efficiency improvement and to time. To go from ecodesign type 1 to type 4, increasing degrees of innovational freedom are needed. This also leads to potentially higher eco-efficiency improvement rates (Y-axis). An improvement in the eco-efficiency rate by a factor 2, as indicated for type 1 ecodesign innovations, means a 50 per cent reduction of the life cycle environmental impact. A factor 20 improvement rate means a 95 per cent reduction. Of course, the degree of eco-efficiency improvement also depends on the type of product, service or system in question.

The time scales shown are only indicative. Ecodesign practice proves that although a company can start with the easy type of product improvement, it can also decide upon the immediate introduction of a more demanding type of ecodesign innovation. One company can even organize parallel trajectories of different types of ecodesign innovations at the same time. However, the more comprehensive design innovations require longer preparation. From the point of view of achieving sustainable development on a global scale, several leading environmental research institutes, such as the World Business Council for Sustainable Development, the Sustainable Technology (DTO) Programme in the Netherlands, and the Wuppertal Institute in Germany, estimate that an eco-efficiency increase with a factor of 10 to 20 will be necessary in the longer run (in 50 years), taking the expected world population growth and Western prosperity levels as points of departure.

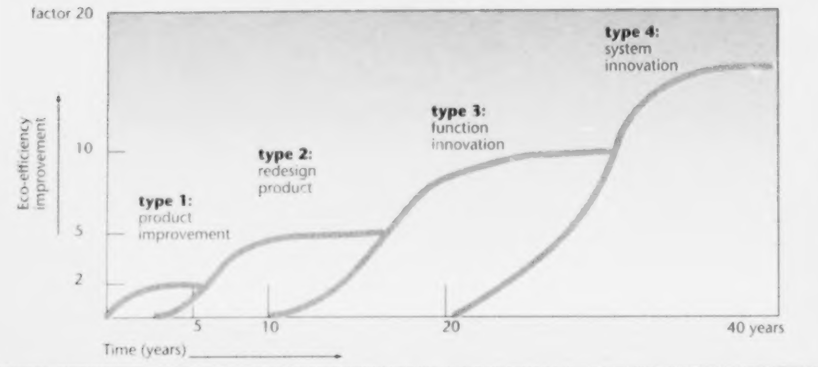
All four types of redesign mentioned in Figure 1 are environment-driven innovations, but they have different characteristics.

Type 1 is *product improvement.* Existing products are being adjusted and improved from the perspectives of pollution prevention and environmental care. The product itself, and the production techniques, will in general stay the same. Mainly the adjustments made will be, for example, organization of a take-back system for tyres, changing raw materials, changing the type of coolant used, or adding on technology such as anti-pollution devices.

Type 2 is *product redesign.* The product concept will stay the same, but parts of the product are developed further or replaced by others. Product redesign aims at: increased use of non-toxic materials, increased recycling and easy disassemby, increased reuse of spare parts and raw materials, or minimizing the energy use at several stages in the product life cycle.

Type 3 is *product concept innovation.* Here the

Figure 1
Four types of ecodesign innovation



way the function of the product is fulfilled is changed. A change from paper-based information exchange to E-mail, or from private cars to "call-a-car" systems, are examples of changes in the way a product function is fulfilled.

Type 4 is *system innovation*, in which new products and services arise, requiring changes in the related infrastructure and organizations. A changeover in agriculture to industry-based food production, or changes in organization, transportation and labour based on information technology, belong to this type of innovation.

Types 1 to 4 have increasing potential to bring about environmental improvements. Some examples of ecodesign practice are given below.

Ecodesign practice

The now emerging type 2 (redesign of an existing product) is given detailed attention in the UNEP ecodesign guide. Examples of its application can be found in industrial design practice in Europe, the United States and Australia, but also increasingly in product-developing industries in other parts of the world. To show the relative ease of application of this type of approach, examples will be given from the programme for industrial design engineers at Delft University. These redesign projects were executed by graduate students within companies during a period of six months. The students were coached by a team of staff members from Delft University and the company. In these projects the UNEP ecodesign methods were successfully applied.

Sony Videco

Assignment

The Videco project concerns the concept development of a Sony VHS Video Cassette Recorder (**Figure 2**) with qualities that minimize the environmental burden during its life cycle. During the orientation phase, the VCR market and the environmental burden of the product were studied. The orientation concluded with the formulation of concrete product components or product qualities on which the design should concentrate:

- component configuration;
- assembly methods;
- front panel;
- printed circuit boards;
- stand-by;
- end-of-life scenarios.

Results

With the help of a morphological overview of design options, the different solutions were combined in potential concepts. The concepts' most promising aspects were selected for further elaboration. This resulted in a new design with the following environmental benefits:

- All passive parts are made of monomaterials and therefore will be recyclable.
- Rapid access to an active part results in easy repair and maintenance.
- Energy use by the stand-by functions is expected to be 1 watt or less.
- Connection to the electronic bus system eliminates stand-by energy consumption.
- Access to the digital network enables upgrading of control and programming features without the need to buy a new device.
- The product structure of the new design enables rapid disassembly, in 44 seconds.
- Overall environmental impact improvement, according to the "eco-indicator", is 61 per cent compared with the existing product.

Office furniture for the Chinese market

Assignment

In north-east China, co-operation had been established with the Harbin Engineering University and Harbin Sida Furniture Company Ltd. An inventory was made of future possibilities and problems concerning environmental product development. The method was a practical approach: a product development process to improve the performance of the Sida company with respect to product-related environmental quality (**Figure 3**).

Project

An analysis of the company and its surroundings, together with data on environmental problems relevant to Sida company products, led to design strategies that lower environmental impact (LiDS-wheel, van Hemel, 1992). A new material-extensive concept was developed to fulfil at least the same functions as the chosen reference product. This reference product is an office furnishing system with a prominent role in partitioning.

The final concept is a relatively cheap, easy to produce, and attractive office furniture system. Compared with the most relevant competitor in this field (the reference product), the new concept has the following advantages:

Environmental merits

- 46% mass reduction;
- 67% energy reduction in production;
- 36% urea-formaldehyde reduction.

General merits

- more flexibility and efficiency in office lay-out, since all elements can be used alone or linked;
- easy (dis-)assembly meets the need for regular change of the formation;
- better ergonomic performance, especially considering the increased use of computers;
- walls can feature translucency (spreading daylight) and sound absorption.

Energy-efficient lighting system for Costa Rica

The Sylvania Company in San José, Costa Rica, develops lighting for the Central American market. As a consequence of its environmental policy, the company aims to reduce the environmental impact of its products.

The starting point of the environmental analysis was a reference product, in this case a Sylvania lighting fixture. Since its environmental impact was highest during the user phase, the decision was made to focus on higher energy efficiency. In addition to reduced energy consumption, the final design proposal included an increase in quality. This ecodesign strategy will have a positive influence on the environmental impact of the product and also presents good marketing opportunities.

General improvements

- improved aesthetic value;
- more functions for the user;
- adequate ergonomic performance;
- relatively low cost;
- product flexibility through offering different functions and styles.

Environmental improvements

- energy consumption reduced 65% (estimated);
- mercury content reduced 50%;
- paint used reduced 40%;
- copper used reduced 65%;
- 42% weight reduction;
- 65% volume reduction.

Take-back and reuse of professional coffee-machines

Veromatic, a Dutch company, develops, produces and sells drink machines. The greater part of sales are to the German market. Veromatic expects that German buyers will return their products at the disposal stage because of the take-back obligation. Research has been carried out to prepare the company for the future, the main question being to determine which take-back and reuse system is the most ecological and economically efficient. During the study, four scenarios were worked out:

- in-house disassembly, reuse of components and materials;
- disassembly by a recycling company, reuse of components and materials;
- selective in-house disassembly, remainder to shredder company;
- total product to shredder company, reuse of materials.

Results

Using the ecodesign strategy wheel, environmental improvement options were generated for short- and long-term implementation.

Short-term: The research made clear that it is possible to reduce the size of the boiler from four to two litres, with polystyrene used for insulation. Energy loss to the air would thus be reduced from 44 to 7 per cent.

Long-term: A logistical system has to be set up for taking back old machines. Over the short term, the old machine should be shredded. By changing the design of the machine, in the long term valuable parts could be profitably reused and other parts could be recycled.

Solo-taxi in the Philippines

The subject of this study was the customization of a solo-taxi (motorcycle suitable for professional one-passenger transportation) for the Norkis Trading Corporation (NTC) in Cebu, the Philippines. The project is expected to result in a new concept, more environmental and economically efficient, of this type of solo-taxi. It began with an internal and external analysis of NTC. Later, the urban public transportation systems were reviewed. This analysis led to the identification of environmental priorities, which in turn contributed to the formulation of (re)design strategies. The durability of the motorcycles was considered, as well as fuel economy and the reduction of hazardous exhaust gases.

General improvements

There was a 50 per cent reduction in the cost of the overall solo-taxi customization. Reduction in materials costs reached 70 per cent. Improvements included increased convenience for driver and passenger (for example, increased possibility for the passenger to secure his/her position, hand luggage carrier and adjustable foot rest for passengers). The image of the customizaton, and of the solo-taxi as a whole, became less heavy and speedier.

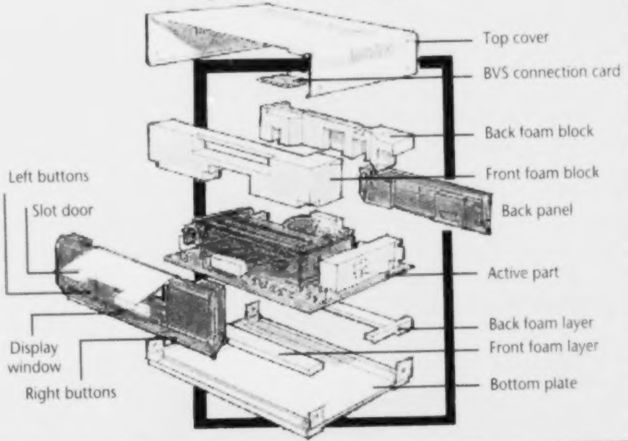
Environmental improvements

The main environmental improvement was a 79 per cent weight reduction. This was achieved by using aluminium. The production of aluminium is more energy-intensive than that of steel. However, the environmental gains due to overall weight reduction, enhanced durability, and the elimination of electroplating easily offset these negative environmental impacts. Environmental improvements included:

- 75% materials reduction;
- elimination of electroplating;
- enhanced durability;
- reduced transport volume.

The positive results of these student projects, with the application of the UNEP ecodesign methods, may give us hope for an energetic diffusion of this type of ecodesign innovation. However, a prerequisite for successful results will be a basic understanding by users of the manual of the process of systematic product development. In my opinion, what is needed is a systematic introduction of the concept of ecodesign and the setting up of many full-scale demonstration programmes such as we have seen developed to introduce the process-oriented cleaner production approach. The UNEP/World Bank demonstration programme in China could be a useful model. By this means it will be possible to develop an ecodesign approach in which, besides typical ecodesign items, extensive attention is also given to the basic process of systematic product development, particularly in relation to existing design procedures in companies in these countries. The Delft University of Technology, for example, started an Ecodesign III Programme with this objective.

Figure 2
Exploded view of Videco



Furthermore, an interesting condensed version of the UNEP approach has been developed by the Innovation Centres in the Netherlands. This approach, which aims particularly at SMEs, has so far been applied with good results in more than 300 SMEs in the Netherlands.

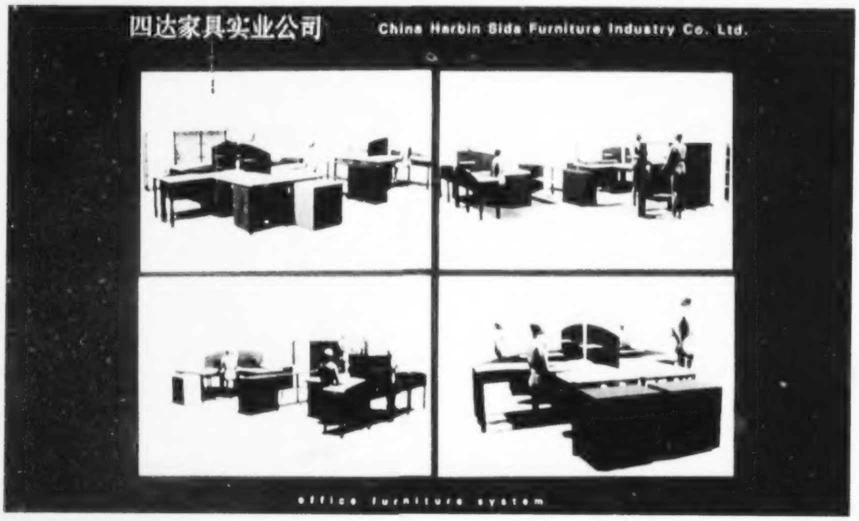
Future developments: needs and recommendations

As can be seen from Figure 1, ecodesign innovation types 1 and 2 are considered able to increase eco-efficiency up to a factor 5. To reach the eco-efficiency level required for a sustainable world economic situation, we need types 3 and 4 (up to a factor 10). Therefore, research is already being undertaken into the potential of type 3 ecodesign innovation, aiming at alternative ways of fulfilling functions that nowadays are completely fulfilled by physical products. In this context, Stahel and Manzini in particular have developed the concept of "service products", whereby *materialized* products are being substituted by *less materialized* services, fulfilling user needs in a more eco-efficient way. To realize this, strategic design activities are necessary, aimed at promoting new services in terms of practical solutions. These new services must be both socially and economically acceptable to the users and must create new market opportunities for the producers.

A practical application of the service-product approach can be found in the recent "car- sharing" experiments in the Netherlands. In this experiment, consumers no longer buy a car but share the use of it with other people from the same neighbourhood. Special car-sharing agencies have been established to create this new local service. According to an evaluation of recent experiments, a reduction of 50 per cent in car fleet size has been achieved, along with an average decrease of 37 per cent in auto mobility (mileage) compared with the old situation. A design research study indicates that collective washing services, at both neighbourhood and city scale, could also realize significant (type 3) reductions in water, detergent and energy use provided that transport and drying technology also operated at a sufficient level of eco-efficiency. The fact that such examples of implementable service-product proposals have already emerged gives us hope for the future of this concept. However, it should be realized that the shift towards dematerialization, although attractive from a theoretical environmental perspective, can in practice also bring about unexpected shifts in life cycle impact due to extra energy or transport use of the new service provider. Further design and testing of the service concept in real life must therefore show the way.

Research is now under way to elaborate the perspective of type 4 ecodesign innovation, in regard to the design of new systems. Promising results and a new approach have been developed in this area by the Sustainable Technology Research (DTO) programme in the Netherlands. Scenario techniques and back-casting methods are being used to develop a vision of sustainable function fulfilment by systems in the year 2040. Based on that, specific research and development trajectories are being designed to orient ecodesign innovation that is already going in the direction of that vision of the future, for instance that which considers feeding, housing, transport and processing. As a result of the DTO programme, new combinations of companies are being established which are working jointly on the development of some components of these new systems that can be

Figure 3
Office furniture for the Chinese market



realized within five to ten years. Also, the sustainable technology assessment approach of the programme is now being integrated into the existing design methods of industrial design engineers at the Delft University of Technology.

It becomes clear that, for types 3 and 4, more fundamental and applied research will be needed. Governments in certain Western countries are aware of these needs, and facilitate the establishment of specific programmes and experiments to bring about alternative function fulfilment and system innovation. However, stronger political commitment and continuous financial support are needed. In particular, at the moment no publicly funded international possibilities exist for companies and research institutes to elaborate the new system approach at an international level. A strong need of better possibilities to test new (sub)systems in niche markets ("test gardens") exists for innovations in industry and academia! As far as the diffusion of types 1 and 2 (product improvement and eco-redesign) is concerned, country-level organisms such as UNEP's National Cleaner Production Centres (NCPCs) can be useful instruments. Newly industrializing and developing countries could profit from the ecodesign experiences of some Western countries, both positive and negative, and should, wherever possible, attempt to leapfrog to types 3 and 4! Organizations like UNEP, UNIDO and the World Bank, as well as the EU, should focus a significantly larger part of their innovation programmes on these opportunities.

However, as pointed out already, to realize a sufficiently strong demand from the potential user of ecodesign innovations, stringent national and international environmental policies are a precondition. A more radical improvement of the environmental performance of products is the joint responsibility of producers and governments.

Figure 4
Eco-redesign of a solo-taxi

Within a general policy framework established by governments, producers should initiate the formulation and actual completion of an ambitious innovation process. Governments need to create the conditions which will encourage such a pro-active attitude. The following recommendations detail this government role:

1. To incite pro-active behaviour in companies, the government must make this behaviour financially attractive, for instance by supporting the marketing of environmentally innovative products, by keeping the retail price of such products down through price measures, or by enhancing sales through government procurement policy.
2. The government cannot confine itself to merely stimulating pro-active behaviour. If, at the same time, counter-productive behaviour by companies is not discouraged, this will level off the positive effects of the stimulating measures. It is recommended that product-oriented standards (such as emission requirements) be applied on a wider scale, in order to provide a counterweight to the market-disrupting behaviour of stragglers and spongers. Agreements based on voluntary negotiated agreements (covenants) will be effective.

Finally, it is our conviction that ecodesign will turn out to be one of the major concepts leading towards a more sustainable world future. The work has only just started, and a more fundamental and applied research programme is needed.

For more information: Han Brezet, Delft University of Technology, Tel: +31-15-278.2738, Fax: +31-15-278.2956, E-mail: L.Roos@IO.TUDelft.NL, Web site: http://www.io.tudelft.nl/research/mpo

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Hans Brezet is also Scientific Director of the joint TNO/TU Delft Programme on Sustainable Product Innovation

Eco-design for the real world

John Gertsakis, Senior Programme Manager, National Centre for Design at RMIT, Royal Melbourne Institute of Technology, GPO Box 2476V, Melbourne 3001, Australia

Abstract

The Australian National Centre for Design of the Royal Melbourne Institute of Technology (RMIT) operates a national demonstration initiative known as the EcoReDesign Program. With funding from Environment Australia and the Australian Research Council, EcoReDesign provides Australian companies with design support and environmentally related research and development to help ensure that "greener" products reach the market in Australia and overseas. The article provides a brief description of the programme followed by several case studies illustrating the collaborative work done with industry to design greener products.

Résumé

Le centre national australien de design de l'Institut royal de technologie de Melbourne (RMIT) a lancé une initiative nationale de démonstration baptisée EcoReDesign Program. Avec le soutien financier d'Environment Australia et de l'Australian Research Council, EcoReDesign propose aux entreprises australiennes des services d'aide à la conception et de R&D intégrant des considérations relatives à l'environnement, dans le but d'accroître l'afflux de produits "plus verts" sur le marché australien et à l'étranger. Après une description succincte du programme, l'article présente plusieurs études de cas qui illustrent la collaboration instaurée avec l'industrie pour concevoir des produits plus verts.

Resumen

El Centro Nacional Australiano para el Diseño del Royal Melbourne Institute of Technology (RMIT) desempeña una actividad a nivel nacional de demostración, llamada el Programa de Rediseño ecológico. Mediante la financiación del Consejo de Investigación y de Medio ambiente de Australia, dicho programa proporciona a las empresas australianas una ayuda para el diseño y el desarrollo e investigación en materia ambiental para contribuir a que los productos "más verdes" se generalicen en Australia y en el extranjero. El artículo presenta una breve descripción del programa, seguida por varios estudios de casos que ilustran el trabajo de colaboración efectuado con la industria para diseñar productos más verdes.

Overview

More than ever before, the act of producing and consuming objects is a process that entwines stakeholders beyond the producer and the consumer. Designers, in their collaboration with industry, are constantly dealing with change and new imperatives – in the marketplace, in technology, in materials, in fashion, and in consumer trends and desires.

Product design and development is also coming under the more intense scrutiny of consumer groups, environmental organizations and government regulators, all eager to see greener, safer and more affordable products. Ample evidence suggests that the trend internationally is that approaches such as *eco-design, design for environment*, and *sustainable product development* are gaining momentum. A growing number of companies are looking to design as a means of becoming more competitive and ecologically sustainable over the longer term.

Demonstrating how the design process can integrate environmental factors within a commercial context is a critical step towards reconfiguring the psyche of product designers, engineers, companies, educators and students. It can also directly articulate the fact that design for environment (DFE) doesn't have to result in inferior, odd or undesirable products.

The demonstration approach to DFE has helped shorten and steepen the learning curve for designers and the companies who rely on them. With support from governments, research institutions and industry associations, countries such as the Netherlands, Germany, Norway, Denmark, the United Kingdom and Australia have aimed to accelerate greater enthusiasm and on-the-ground action ahead of the policy and regulatory shift that will otherwise leave industry floundering in search of innovative solutions to serious environmental concerns.

A critical objective of these demonstration programmes is to assist individual companies with the know-how required to design environmentally improved products with reduced life cycle environmental impacts. Ensuring that the product concepts move beyond glossy models and drawings is paramount, as is the need to blend a stronger design and environmental philosophy into company culture, especially at the senior management level. Documenting the entire process and generating information materials for dissemination to other companies and the broader design community directly fulfills the demonstration objective. "How To" manuals, design guides, videos and computer software, collectively, provide first-hand knowledge, methods and guidelines based on specific case studies and real-life commercial experiences.

Evolving Australian activity

In Australia, the National Centre for Design at RMIT operates a national demonstration initiative known as the EcoReDesign™ programme.[1] With funding from Environment Australia[2] and the Australian Research Council, EcoReDesign provides Australian companies with design support and environmentally related research and development to help ensure that "greener" products reach the market in Australia and overseas. The EcoReDesign programme has been pivotal in establishing and advocating the environmental and commercial value of DFE strategies in Australia. The foresight of the previous Federal Government, led by Prime Minister Paul Keating, has facilitated a healthy and active interest in DFE by companies, industry associations, designers, and the community in general.

As a national research centre for environmental design, our projects span the policy and practice of DFE, covering both product design and architecture. The Centre's philosophy has always been underpinned by a strong interdisciplinary focus and the need to consider the social and cultural contexts of environmentally driven design. This aspect is clearly reflected in the diverse range of expertise to found at the Centre for Design – product designers, architects, engineers, scientists, sociologists, artists, and of course both generalist and specialist environmental researchers.

Although the Centre's core activities are very industry-focused, numerous projects also concentrate on more theoretical and strategic aspects. In summary, our activities include:

◆ developing and demonstrating new design methods, tools and processes aimed at improving the environmental performance of products and services;

◆ working with industry to design greener products and services, and to develop more strategic environmental orientations;

◆ advising government agencies on policy and programmes to reduce environmental impacts through design;

◆ exploring new design concepts and scenarios for a sustainable future;

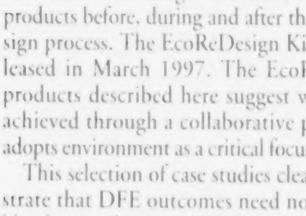
◆ maintaining a national and international network of research and information exchange on environmental design.

In the last three years, collaborative work with seven companies has been documented with a

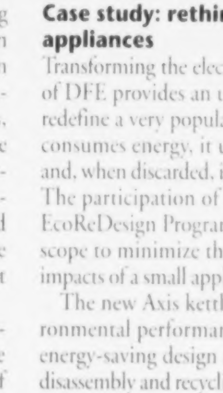
Schiavello HOTdesk™ office workstation

view to producing a comprehensive EcoReDesign Information Kit for those involved in product design and development. The Kit will include a video and a detailed "How To" manual explaining the process and discussing case studies based on the products, people and companies involved in the programme. Interviews with company executives, designers and environmental specialists, combined with images and data, will illustrate products before, during and after the EcoReDesign process. The EcoReDesign Kit will be released in March 1997. The EcoReDesigned products described here suggest what can be achieved through a collaborative process that adopts environment as a critical focus.

This selection of case studies clearly demonstrate that DFE outcomes need not always be bland, unsophisticated products reminiscent of dated design philosophies. Indeed, they cover a breadth of responses characterized by diversity – an amalgam of advanced technologies, smart materials, intelligent engineering, challenging aesthetics, optimal functionality, and, above all, good design. The Centre's World Wide Web site (see below) provides more detailed information about the complete suite of redesigned products and the EcoReDesign programme, including how to access the quarterly EcoReDesign newsletter and the upcoming Information Kit



Blackmores packaging



Case study: rethinking small appliances

Transforming the electric kettle into an exemplar of DFE provides an unmatched opportunity to redefine a very popular small appliance. A kettle consumes energy, it utilizes valuable resources, and, when discarded, it contributes to solid waste. The participation of Kambrook Pty Ltd in the EcoReDesign Programme presented substantial scope to minimize the life cycle environmental impacts of a small appliance.

The new Axis kettle's increased level of environmental performance relates primarily to its energy-saving design and its potential for easier disassembly and recycling - both achieved through an interdisciplinary DFE approach. Early in the design process a life cycle assessment (LCA) was conducted on previous Kambrook kettles to identify the major areas of environmental impact. Of course energy use during kettle operation was the most significant issue in need of design attention, due its contribution to greenhouse gases and global warming.

The design of the Axis kettle was heavily influenced by research that showed that most people reboil the water in electric kettles even when there is no need to. The solution was relatively obvious – keep the water hotter longer. The kettle's double-wall design acts like a high-tech tea cosy (i.e. thermos-type insulator) to reduce heat loss. In order to fully exploit the increased heat retention, a water temperature indicator signals whether reboiling is required. These unique features help save energy by minimizing reboils. Depending on usage patterns, up to 25 per cent less electricity can be consumed on reboils up to 40 minutes after the initial boiling. Although such savings are comparatively small compared with those which can be obtained with larger appliances, the potential should not be underestimated. If every kettle in current use in Australia were replaced with the new Axis kettle, carbon dioxide emissions could be reduced by approximately 300,000 tonnes a year.

Another environmental feature is the kettle's attention to design for recyclability. Specific waste avoidance characteristics of the kettle include:

- 16 per cent reduction in overall weight;
- approximately 50 per cent reduction in number of materials;
- 66 per cent of weight present in one potentially recyclable material (was previously 36 per cent);
- 40 per cent reduction in number of components.

Case study: waste wise packaging

Blackmores Pty Ltd is an Australian manufacturer of natural health products such as vitamin supplements and cosmetics. It is also eager to demonstrate a leadership role in corporate environmental responsibility, and as such joined the EcoReDesign programme to find a more environmentally sensitive packaging system for its cosmetic products.

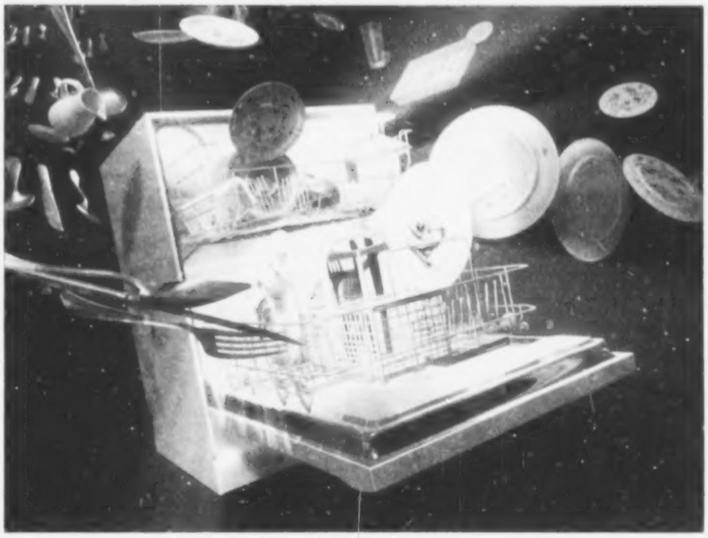
The aim of the EcoReDesign project was to further reduce the environmental impact of the Blackmores packaging by establishing a collection and recycling system for the existing packaging range and designing a more efficient packaging system for the future. A study of recycling opportunities found that the best option would be to establish a return system through retailers, such as health food stores and chemists (apothecaries or pharmacists), which often have a dedicated Blackmores display stand. As a result, a packaging recovery stand has been designed for returned plastic packaging. The returned packaging will be sent to a recycler for manufacture into products made from mixed plastics, such as street furniture.

The second stage of the project involved the design of a "new generation" packaging system which has a much lower impact on the environment. The system combines a lightweight disposable package and an attractive, strong and reuseable container. Disposability and reuse of lightweight packaging provide a more effective solution to the need for waste reduction than conventional approaches such as recycling. Concepts include new designs for:

- *Tubes*. Rather than using a plastic tube, creams could be packaged in a single-use sachet and a long-life reusable "frame". The lightweight sachet (minimal material) would be thrown away when empty and a new sachet fitted to the frame.
- *Tubs*. The alternative to tubs is a lightweight disposable pack which is placed inside an attractive longer-life container. This container could be

made from a variety of desirable materials, including recycled plastic, biodegradable starch-based resin, timber or metal.

The aim of the new packaging is to conserve energy and materials and reduce waste without compromising quality and convenience. The reuseable component – the tub or frame – is intended to be an attractive product that customers will want to keep and put on display.



Dishlex Global dishwasher

Case study: high-performance dishwashing

Southcorp Whitegoods Pty Ltd is one of Australia's largest manufacturers of whitegoods. It also owns the country's most popular dishwasher brand, Dishlex. Through the EcoReDesign programme, Dishlex has developed the new Global range of high-performance electronic dishwashers.

Southcorp joined EcoReDesign to enhance its existing expertise in dishwasher design. In particular, the Centre introduced a range of skills related to life cycle assessment, design for disassembly and recycling, and strategic product development.

A life cycle analysis (LCA) of existing Dishlex dishwashers highlighted the key areas in need of environmental redesign, i.e. energy and water consumption during operation. Global trends in waste minimization policy and other market intelligence suggested that attention to design for recycling should also be pursued. This substantial body of research, undertaken through the Centre, provided Southcorp with otherwise difficult-to-access environmental data and, more importantly, the foundations to design one of the world's most ecologically advanced dishwashers.

The "EcoReDesigned" dishwashers represent a new benchmark in energy and water efficiency. As an indication, if every dishwasher in current use in Australia were replaced by the new Dishlex model, we could save approximately 10 billion litres of water – and reduce carbon dioxide emissions by 700,000 tonnes – a year. Design features enabling such environmental improvements include:

- a six-star energy rating, the highest rating ever achieved by a dishwasher designed and manufactured in Australia;
- wash programmes compatible for enzyme-based detergents;
- an AAA water conservation rating, the highest possible in Australia;
- a four-stage micro-filtration system to increase efficiency of water use.

The Dishlex range has also integrated waste avoidance design features aimed at keeping discarded dishwashers out of the waste stream:

- plastic components coded to enable easier identification during recycling;
- fewer material types, aimed at increasing recycling efficiencies;
- major components designed for disassembly and recycling;
- material efficiencies (the Dishlex is 7 kg lighter than previous models).

Case study: greening the future office

Through the EcoReDesign programme, Australia's largest producer of office furniture, Schiavello Commercial Interiors Pty Ltd, has moved one step closer to re-inventing the "desk". Working in collaboration with the Centre, Schiavello has developed working prototypes of a new system of office furniture called the HOTdesk™. It is the first Schiavello project to seriously explore the implications that changing work practices, emerging information technologies, and environmental issues may have for the design of office furniture.

The complexity of factors influencing office furniture design demanded an interdisciplinary approach to what EcoReDesign might mean for future Schiavello design projects. The Centre conducted research in the following areas:

- life cycle impacts of existing Schiavello products;
- changing work practices and trends in emerging information technologies;
- environmentally preferable materials;
- environmentally oriented office furniture manufacturers (and their policies);
- survey of existing Schiavello clients.

Kambrook electric kettle

The design brief developed from the above investigations demanded a work station system which not only minimizes life cycle environmental impacts but also exceeds functional requirements. The HOTdesk™ is pointing towards several key areas of environmental improvement:

- implementation of cleaner production techniques;
- greater resource efficiency through the use of fewer materials;
- increased durability and refurbishment opportunities, minimizing contributions to solid waste;
- design for disassembly, to enable more cost-effective reuse of components and recycling of materials;
- high mobility, reconfigurability and refurbishability, minimizing the risk of premature obsolescence;
- minimal contribution to indoor air pollution.

Conclusion

Australia has exceptional technical and creative skills, a general commitment to environmental protection, and a history of innovation born of ingenuity and necessity. Our efforts to link these areas and develop "green goods" for Australian and export markets need ongoing support and recognition. They also need the advantages of more cultural grounding, encompassing the "creative" and the "technical" rather than dividing them. It's not enough to manufacture garden edging, compost bins and drink bottles from recycled plastics. Nor is it adequate to engineer energy-efficient appliances without develo[illegible] schemes to enable their future disassembly and recycling.

Above all, Australia needs a robust DFE approach that blends creative excellence, innovation and technical rigour with a view to fearlessly pursuing major environmental and functional objectives. Ultimately, products have a function and this must remain the designer's priority. The challenge is to assert product functionality whilst simultaneously minimizing life cycle environmental impacts and maximizing competitiveness.

For more information, contact John Gertsakis at the address shown above. Tel: +61 3 9660 3902. Fax: +61 3 9639 3412. E-mail: gertsakis@rmit.edu.au. World Wide Web site: http://www.cfd.rmit.edu.au/Research/EcoReDesign.html

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Environment Australia is an Agency of the Federal Environment Department, Commonwealth Government of Australia.

SONY: addressing different stages of the product's life cycle

Jürgen Günther, Sony TV Europe Fellbach, and Christian Ridder, Project Manager, Sony Environmental Center Europe,
Stuttgart Technology Center, Sony Deutschland GmbH, Stuttgarter Straße 106, D-70736 Fellbach, Germany

The time is long past when some electronics manufacturers tried to make a green impression by covering their products with a thin surface of "paper and wood". For the consumer, it is clear that "green design" is more than just a small change in materials.

Many times the consideration of environmental impacts is part of Sony's normal development activities and is reflected in our standard products. In order to minimize the environmental burden of consumer electronics, we study all the product's life cycle stages. Thus priorities can differ from product to product. This article gives examples of Sony initiatives which have aimed at addressing different stages of the product life cycle.

Design: how to design TV sets for recycling?

What considerations have been taken into account in order to guarantee easy dismantling and recycling of our modern (KV-C2 and KV-C3 series) television sets?

Materials

Only pure and uncontaminated plastic materials can be reused in the injection moulding process. Therefore, compounds are avoided and the use of lacquered materials is reduced to the greatest extent possible. Design changes have reduced the number of materials used. All plastic parts are marked with the symbol of the plastic, so that recyclers will have no problem identifying them. Nowadays only a very small percentage of materials cannot be recycled. Theoretically, only 1 per cent of the product's total weight will need to be taken to a disposal site.

Technology

With the introduction of new technologies, environmental criteria have to be considered in any case. Now, for the first time, the *speaker grille* of the TV set is an integral part of the cabinet. It is produced in one moulding step, together with the cabinet, and thus made of only one kind of plastic. Speaker grilles made of metal, which are interlaced or even welded and therefore difficult to dismantle, are a thing of the past.

Air moulding is another technology which has been put into practice. With the introduction of this moulding technique, the wall thickness of the cabinet – and hence the amount of plastic used – can be reduced drastically. A life cycle assessment carried out by IZT Berlin to compare the air-moulded cabinet, the cabinet of a reference set (a hypothetical set based on three normal TV sets with plastic cabinets), a steel cabinet, and one mixed cabinet showed a clear advantage for the air-moulded cabinet. This technology has advantages not only from an environmental point of view, but also because of its better mechanical qualities and lower production costs.

Disassembly

Disassembly time, i.e. the time necessary to dismantle the product and sort the components according to materials, has been drastically decreased. Disassembly can be performed with common tools or even, in the case of snap and slide connections that can be opened easily, by hand. The rear cover can be removed by unscrewing five self-tapping screws and opening two snap-in connections with marked positions.

The second step is to remove the electronic chassis, which can be easily done by lifting the chassis frame. The printed circuit boards on the chassis have to be considered as a separate fraction. In the recycling process they will be shredded and separated into metal and plastic parts.

The speaker boxes are held in the cabinet with two foam cushions each. In dismantling, the boxes merely have to be pulled out!

Finally, the picture tube is attached to the plastic cabinet with only four screws. No metal fixing elements are used in the cabinet. The remaining small parts (also made of polystyrene) can be sent to recycling without being dismantled. Furthermore, it should be noted that only water-based lacquer is used on the front of the cabinet.

Production: loudspeaker cabinets made of recycled Tetra-Paks

Designing a product to be recycled is one thing, but actually using recycled material in the production of new products is another. The cabinet of the SS-BG 30 loudspeakers is Tectan, a material made of shredded and pressed Tetra-Pak cartons. Use of this relatively heavy material, which contains 20 per cent polyethylene and 5 per cent aluminium, results in better sound quality than that of similar boxes made of conventional materials.

Use: 40 hours on one charge

In 15 years of Walkman history, innovation has never stopped. There have been functional as well as environmental improvements. Forty hours of continuous playing time (WM-EX 2 model) avoids the waste of many batteries.

Service and repair: refurbishment instead of disposal

This innovative repair service is designed for portable products with a large volume of sales and low production costs. For this kind of products the traditional service activity was to process each set as an individual repair. Compared with the product price, repair was often more expensive than purchasing a new product.

Refurbishment is the repair of broken products, combined with an "aesthetic upgrade" of the repaired product by replacement of cosmetic cover parts. Refurbished products are offered to the customer who brings his broken product for repair. The customer does not have to wait for the repair, but immediately receives an already repaired and refurbished product.

Since all broken products are shipped in large quantities to one central refurbishment centre, transport and repair are much more cost-effective than before. This makes a repair a more attractive alternative for the customer and for the company. Waste and scrap are reduced, and an increasing number of products can start a "second life" as refurbished products. Since the environmental impact of refurbishment is much lower than the impact of the production of new products, this has a positive effect on our environment.

Disposal: how to get rid of your monitor in an environmentally sound way?

In Germany a "take-back label" is part of every Sony monitor sold since March 1996. When the monitor is to be disposed of, the customer simply sticks the label on the product and returns it to one of 800 take-back points. In cooperation with Rethmann Electrorecycling GmbH, Sony guarantees that the monitor will be dismantled and recycled in an environmentally sound way.

Managing eco-design

Martin Charter, The Centre for Sustainable Design, Surrey Institute of Art and Design, Falkner Road, Farnham, Surrey GU9 7DS, UK.

Abstract

Business is focusing increasingly on products' environmental performance. Product design and development which considers a product's environmental impacts is a new area. "Eco-design" or "Design for Environment" (DfE) refers to the systematic incorporation of environmental factors at this stage. To move beyond this stage towards "Design for Sustainability" (DfS) or "Sustainable Product Design" (SPD), new structures, skills and systems will be required.

Résumé

Les entreprises s'intéressent de plus en plus aux performances des produits en termes d'environnement. La conception et le développement de produits prenant en compte les impacts sur l'environnement constituent un nouvel aspect de cette démarche. "Ecodesign" ou "Design for Environment" (DfE) désigne l'intégration systématique de facteurs environnementaux au stade de la conception et du développment. Pour aller plus loin encore, vers un design visant la viabilité écologique ("Design for Sustainability" ou DfS) ou vers la conception de produits durables ("Sustainable Product Design ou SPD), de nouvelles structures, de nouvellles compétences et de nouveaux systèmes seront nécessaires.

Resumen

La economía otorga cada vez mayor importancia a los resultados medioambientales de los productos. Un nuevo campo aparece con el diseño y desarrollo de los productos que toma en cuenta el impacto medioambiental de los mismos. El "Diseño ecológico" o "Diseño para el medio ambiente" (DfE) trata de la incorporación sistemática de factores medioambientales a este nivel. Para sobrepasar dicho nivel, y alcanzar un "Diseño para la Sostenibilidad" (DfS) o un "Diseño Sostenible de Producto " (SPD), se requerirán nuevas estructuras, competencias y sistemas.

Introduction

All products and services have an impact on the environment. Products are made from materials which are derived from the environment and must return to it at some stage. Design and development predetermine a product's environmental impact at the start of its life. This is an influence which extends beyond the product's useful life, as all materials will usually have to be converted or transferred before they are returned to the environment.

Environmentally-considered product design and development is a new area, with a wide range of definitions, generally either broad-based or specific. Eco-design, or Design for Environment (DfE), refers to the systematic incorporation of environmental factors into product design and development – eco-design being the European term and DfE the North American one. To date, most activity has centred on redesigning existing products, but in the next phase innovative new products and services and, more fundamentally, new system solutions will be developed.

Management of eco-design is in its early stages, with a lack of best practice examples and models even within the world's largest companies. If we are to move beyond eco-design towards "Design for Sustainability" (DfS), we need to develop new approaches to balance economic, environmental, ethical and social issues in product design and development. The challenge will be to move from redesign to rethink. Unless stated otherwise, the term "eco-design" as used in this article means the systematic incorporation of environmental considerations into product design and development.

Eco-design review

Before a company embarks on an eco-design programme, a range of questions need to be addressed in relation to environmental management and product design processes.

Environmental management

- ◆ Do we have eco-design objectives?
- ◆ Do we have eco-design metrics?
- ◆ Do we have an eco-design policy?
- ◆ Have we established an eco-design strategy?
- ◆ What is the eco-design programme?
- ◆ Is there a plan to communicate the benefits of eco-design internally/externally?
- ◆ How is the company selling eco-design internally/externally?
- ◆ Has an eco-design information system been established?
- ◆ How is the eco-design information system managed/coordinated?
- ◆ How is the eco-design programme being implemented?
- ◆ Has an eco-design pilot project been established?
- ◆ What are the eco-design issues for suppliers?
- ◆ How are reverse logistics being managed?

Product design

- ◆ What are the legal issues?
- ◆ What are the materials issues?
- ◆ What are the energy issues?
- ◆ Have environmental issues been considered in CAD?
- ◆ Is the company using Life Cycle Assessment (LCA)?

Historically, product designers have neglected to use their influence on what a product is like after it has served its functional purpose. However, increased costs of waste disposal and product take-back legislation are changing this. A major objective of eco-design is to minimize total life cycle impacts and costs. Solutions include the extension of the useful product life through reuse and remanufacture, and design for "end of life", which concentrates on the safe disposal and reintroduction of materials into the market.

In the last ten to 15 years various concepts, systems and approaches have been developed to achieve the goal of producing less environmentally impactful products – essentially the development, or redevelopment, of products with the environment in mind. Eco-design practices are intended to be comprehensive, multi-disciplinary approaches to integrating environmental concerns and constraints into product design and development procedures and will require multi-functional communications.

The primary focus of eco-design has been on the improvement of existing product design and development. A range of drivers are now emerging that will influence eco-design, including "producer responsibility" and ISO 14001. A range of tools are also emerging to support designers, but there are as yet few resources for managers. Eco-design issues need to be understood by management. To enable new business visions to be realized, product service and system innovation concepts must be developed. If the levels of change required for sustainability are to achieved, there is a need for product or system innovation.

What are the pressures for eco-design?

A diverse range of pressures are moving business to focus on improving products' environmental performance. A number of key issues affect eco-design, some of which are highlighted below.

Eco-labelling

In Europe, Canada and Japan, eco-labelling schemes award "seals of approval" to products that are less harmful to the environment than other products in their class. These programmes cover diverse products, ranging from paper products

Case study: eco-design in practice at Wilkahn

Wilkahn is a medium-sized, family-owned company with headquarters near Hanover in northern Germany. This company, which manufactures and distributes a range of office seating and tables, has 600 employees in Germany and a worldwide turnover of DM 130,000,000.

Early in its development Wilkahn adopted the design principles of the German Bauhaus school and, as long ago as the 1950s, introduced a design philosophy of "long-term validity" which committed the company to designing products which were "true and honest and did not mislead the customer about their value, function and quality." This principle continues to guide the company's approach.

Eco-design has been fully integrated into the product development process at Wilkahn, with product management being the responsible division. Ecological responsibility is an integral part of the design process, along with the two conventional design criteria: form and function. If ecological issues are forgotten at the design stage, it requires money, time and energy to make a product cleaner and greener at a later stage. A considerable amount of investment has gone into Wilkahn's product range in order to reduce harmful impacts.

Wilkahn has recently introduced an ecological checklist for product development to ensure that products are kept simple, longevity is maximized, materials are reusable, and design has long-term appeal. A product should last ten to 15 years, not just from an ecological or quality standpoint but also from the aesthetic point of view.

The first product to which the ecological checklist was applied was the Picto chair. For this 95 per cent recyclable product the company used materials which, although they are more expensive than traditional ones, are less environmentally harmful. The designers were able to offset the higher cost of the environmentally friendly materials by innovative design using fewer parts. This application of the "less is more" concept is also applied to other Wilkahn products. For example, the back of the new "Modus" chair is made from a fabric rather than from polypropylene, and the company is designing chairs with single-lever position and tension control to further reduce the number of parts. The aim is to encourage designers to make quantum leaps in thinking and to introduce new office furniture concepts and systems.

and paints to household appliances and construction materials. The first eco-labelling programme, which awarded the German "Blue Angel", was established in 1978. By 1990, 3200 products in 60 product categories had received the Blue Angel and this symbol was recognized by almost 80 per cent of German households.

In response to the proliferation of eco-labelling schemes, the European Union adopted an eco-labelling Regulation in 1992 to provide some consistency among Member States. The programme awards eco-labels to products that meet specified environmental performance criteria defined for individual product groups. The criteria are based on an assessment of the product's major environmental impacts throughout its life cycle.

Pollution prevention

Pollution prevention is generally presented in the form of a hierarchy of choices. In descending order of desirability, the major options are:

Source reduction. Simply using less and practising good housekeeping provides "green" benefits and reduced costs. When eco-design principles are applied, this also requires designing products so that less pollution is generated throughout the life cycle. For example, if a durable item like an airplane or automobile has a lifetime of years or even decades, it is likely that maintenance, not the original manufacturing processes, will generate the most waste.

Substitution. Toxic materials and processes generating toxic waste can be replaced with less hazardous alternatives. In many cases, this may involve rethinking product design, or upstream or downstream process requirements, and replacing existing capital stock. "Drop-in" substitutes tend to be rare.

Recycling. Materials generated during the life cycle of a product and which cannot be eliminated should be recycled, reused or refurbished. For example, maintenance of some types of electronic equipment, such as copiers, requires periodic replacement of certain functional units. These units should be refurbished and returned to the "business cycle". Where this cannot be done, they should be designed using recyclable materials and a return/recycle programme developed.

Legislation. Environmental law is primarily focused on corporate environmental activities, but the trend will be to "design out" problems and environmental risks at source. "Producer responsibility" and "take-back" are beginning to receive attention in the electronics, packaging and automobile sectors.

Corporate environmental objectives. The environmental performance of companies and products is increasingly being measured. For instance, Du Pont has recently made a public commitment to zero emissions by 2015. Such commitments are forcing companies to re-engineer processes, and are leading them to focus on source reduction issues and therefore materials and energy reduction at source. It is likely that there will be more pressure on suppliers to design components, sub-assemblies, and products in which environmental benefits have been incorporated.

Table 1
Results of the Mintel survey of consumers

	1990 (%)	1994 (%)
Don't know	8%	3%
Unconcerned	10%	7%
Armchair green	23%	28%
Pale green	20%	21%
Dark green	27%	28%
Very dark green	12%	13%

Source: The Green Consumer, Mintel International, 1994 Environmental Codes and Standards

The "green" consumer. Although there is a lack of reliable comparative data, the green consumer is certainly a worldwide phenomenon. In the UK interest in environmental issues appears to be holding firm, with greater sophistication among green consumers likely in the next wave of economic prosperity. In addition, other stakeholders, for example employees, insurers and bankers, are becoming increasingly interested in firms' environmental performance.

In 1994, Mintel International studied a representative sample of 981 adults to determine whether consumers were prepared to modify their purchasing habits according to their environmental principles. The study showed that most shoppers had increased their purchases of products marketed with a green image, but there was growing concern over the integrity of the activities of the corporations which made the products. The number of people who declared themselves interested in "green" issues in 1994 had increased by 10 per cent compared with 1990. The results of this survey are shown in **Table 1**.

A range of voluntary environmental codes for business has also been developed, several of which explicitly mention the need to take account of products' environmental impact. The Energy Star programme in the US has made energy efficiency an issue in the purchasing of information technology products. One of the 16 principles of the International Chamber of Commerce's "Business Charter for Sustainable Development", which has an estimated 1500 signatories, also specifically mentions product responsibility: "Products and Services: To develop and provide products and services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused or disposed of safely."

ISO 14001

The forthcoming ISO standards from the International Organization for Standardization, and the Eco-Management and Audit Scheme (EMAS), require consideration of product design and development issues. Adhering to environmental standards will increasingly be required of suppliers.

Where are we now?

The key conclusion arising from recent studies of eco-design management is that such programmes are in their infancy even in some of the world's largest companies. Eco-design objectives and strategies exist, but often appear vague and unclear.

There are few examples of best practice, frameworks or models. It appears that eco-design is "owned" and driven by environmental management, rather than by design management or product design. Legal and customer issues appear to be important drivers, with companies in certain market sectors mentioning that environmental performance is becoming a competitive issue. Major obstacles are perceived to be cost and organizational inertia, with individual motivation appearing to be a key factor in the development of eco-design from both a management and product design perspective. However, eco-issues do not generally appear to be percolating down to product designers, who appear to receive little pressure to incorporate "green" issues into clients' briefs. The next challenge will be to develop clear examples of business benefits derived from eco-design projects and programmes.

Sustainable Product Design (SPD)

Achieving sustainable development will require significant reductions in our use of resources and energy. In fact, many experts believe that to do this we must increase efficiency in these areas by as much as four or ten times. If these "Factor 4" or "Factor 10" levels are to be attained, we will have to develop breakthroughs in thinking. There is a need to move from redesign to rethink, which will mean a new emphasis on creativity. A key issue will be the need to move towards "dematerialization", away from products and towards services. For example, we may move from books on paper to books in electronic form.

A key aspect of SPD is the consideration of social and ethical issues alongside economic and environmental ones in product design and development. Since the 1970s many of these issues have been discussed in relation to corporate social responsibility, but this has not percolated down to the level of product design and development.

To move forward, we need to innovate and think differently. The concept of eco-innovation is evolving. However, many of the issues embedded in social and ethical innovation are more difficult to define.

If we are to move beyond eco-design towards Design for Sustainability (DfS), we need to develop new approaches to balance economic, environmental, ethical and social considerations in product design and development. The Centre for Sustainable Design has developed a working definition of SPD: "SPD is a design management practice which has as a key element the need to ensure that economic, environmental, ethical and social needs are balanced. SPD acknowledges the need to develop innovative product and service concepts which minimize environmental, ethical and social impact throughout the life cycle. SPD is a systems-orientated approach that recognizes the need to form broader stakeholder relationships and partnerships. The aim is to produce zero emissions."

Conclusion

There is a need to develop better frameworks for the management of the eco-design process, and to provide more appropriate training, information and tools for designers. Design can play an important role in producing more eco-efficient products, and ultimately in producing more sustainable solutions to existing and new product and service problems. If this is to be made possible, there is a need to win senior management commitment to the process and to facilitate discussion between environmental, marketing, design and other business functions as well as with external stakeholders such as customers and suppliers. Designers, for their part, will need to develop a broader understanding of the interaction between environmental and social systems and to look for "closed-loop" opportunities to extend existing products and to reuse waste throughout the life cycle. A key issue will be educating business people, particularly customers and marketers, about the opportunities arising from the sustainability agenda. If eco-design and ultimately Sustainable Product Design (SPD) are to move from the "think tank" to "real life", it will be essential to understand the organizational reality of the concept and generate business benefits for products, services and systems. To achieve balanced "quadruple bottom-line" solutions to sustainability's complex, evolving and changing problems and opportunities, managers and designers will need to develop the ability to "think"; to "think creatively" and to "think out of the box"! Clearly, "business as usual" will not do; new structures, skills and systems will be needed.

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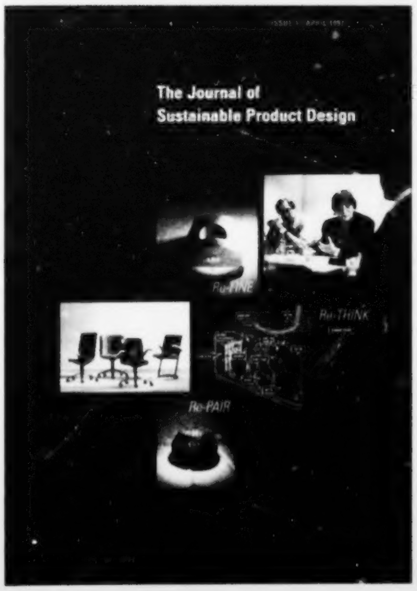

News from The Centre for Sustainable Design: The Journal of Sustainable Product Design

The Journal is a quarterly publication covering the complex issues surrounding the implications of the economic, environmental, ethical and social issues in product design and development. Editorial balances practical issues as they affect us today, as well as exploring new ideas and thinking. The journal focuses on a wide range of issues from managing the eco-design process to dematerialization and Life Cycle Assessment (LCA) and eco-innovation. Importantly, the journal will cover a broader agenda than environmental issues in product design and development. The first issue was published in April 1997.

The journal will provide objective analysis, with articles from leading thinkers and practitioners around the world. There will also be case histories, interviews, research, a section on innovative ideas, a gallery of product images, reviews, and a diary of events. A unique feature will be a downloadable Internet version of the journal.

The journal is edited by Martin Charter and Anne Chick from The Centre for Sustainable Design, with the support of an international editorial board.

For more information, contact:
Martin Charter
Joint Coordinator
The Centre for Sustainable Design
Surrey Institute
Falkner Road
Farnham, Surrey
UK
Tel: 01252-732229
Fax: 01252-732274
Email: cfsd@surrart.ac.uk
Internet: http://www.cfsd.org.uk

The UNEP Global Environmental Citizenship Programme: an overview

Alicia Bárcena,[1] Senior Adviser on Global Environmental Citizenship, United Nations Environment Programme, Boulevard de Virreyes 155, Mexico, D.F., Mexico

Abstract
The Global Environmetal Citizenship (GEC) Programme can play a significant role in increasing awareness of environmental issues worldwide, in particular through the use of existing information networks. By encouraging the Global Environmental Citizenship concept, UNEP wiill seek to facilitate the participation of influential international groups or associations (described here) in well-informed voluntary activities related to global environmental issues.

Résumé
Le programme Global Environmental Citizenship (GEC) peut être d'une grande aide pour sensibiliser des sphères toujours plus larges de l'opinion publique mondiale aux questions d'environnement, notamment par l'intermédiaire des réseaux informatiques existants. En encourageant la notion de citoyen du monde respectueux de l'environnement, le PNUE tentera de faciliter la participation volontaire d'associations ou de groupes internationaux influents et bien informés (qui sont ici décrits) à des activités relatives aux problèmes d'environnement dans le monde.

Resumen
El Programa de Ciudadania Ambiental Global (GEC) puede llegar a contribuir significativamente en desarrollar una toma de conciencia masiva a nivel mundial acerca de los temas relativos al medio ambiente, en particular mediante la utilización de las redes de información actuales. Al promover el concepto de Ciudadania Ambiental Global, la UNEP tratará de favorecer la participación de grupos influyentes en la esfera internacional, o bien asociaciones (mencionadas aquí) en actividades voluntarias, ampliamente documentadas, respecto a los temas medioambientales globales.

As we come to the end of this millennium, humanity is facing unprecedented challenges. Our world is becoming increasingly interconnected. It is affected by global flows of information, capital and technology, as well as environmental changes and cultural influences. Citizens around the world are more concerned today about environmental problems than they were five years ago, when public opinion forced major improvements in environmental protection. In spite of their leaders' preoccupation with economic issues, citizens are even more likely today than five years ago to say that economic growth should be sacrificed if necessary to ensure that the environment is protected. They are also even more convinced that their health, and especially their children's health, is being harmed by environmental degradation and by pollution. And they are sharply critical of both government and industry inaction.

As a response, people at all levels are searching for new modes of organization and participation. Gradually more and more people are realizing the need to organize themselves and to act collectively to influence social change.

The information revolution has influenced the development of new forms of democracy and social participation. The emergence of powerful electronic networks such as the Internet has created numerous opportunites for more horizontal communication, as opposed to the traditional vertical structures of transmission. This can give people direct access to information on many environmental topics.

The nature of these new relationships and interactions is creating the basis for global citizenship. This concept includes the notion of rights and responsibilities in relation to planetary problems. The planet's capacity to support human life is being pushed to the limits. Society is confronted with a challenge of unprecedented proportions: it literally must manage its own future collectively in a globalized world. A global citizenry that understands its rights and duties in all walks of life, and exercises them responsibly, is necessary to preserve the ethical dimensions of humanity.

There presently exist a multitude of global organizations representing different sectors of society. They have established networks to exchange ideas and information relevant to their interests.

In this context, Global Environmental Citizenship is about asserting the ethical responsiblities of individuals, organizations, communities, corporations and others to create new forms of solidarity to protect all life on Earth.

Global Environmental Citizenship is a UNEP initiative based on the principle that each sector of society requires a different educational strategy that fits its needs. UNEP should tailor each educational campaign to the particular group involved, taking into consideration the concerns of the targeted actors. Through understanding the concerns of each group, UNEP can be more effective in presenting information and knowledge in accessible and user-friendly formats. UNEP thus seeks to play a significant role in facilitating the participation of these groups in promoting well-informed voluntary action.

During the pilot phase, efforts focused on building alliances with groups that have great potential to influence policies and bring about change towards the attainment of more environmentally sound, sustainable and equitable patterns of consumption and production. A pilot activity was undertaken with a global network of consumer groups, "Consumers International" (CI) (see article in this issue). A joint agreement between CI and UNEP was signed which includes a two-year strategy. A first product of this joint effort was a tool kit on "Safe Food for All" to be presented at the FAO Global Conference on Food for All.

The tool kit, produced with the support of Environment Canada, contains repackaged information produced by UNEP on three topics: biosafety, chemicals and ecolabelling. It was disseminated to the over 200 CI members in around 90 countries with the idea that these national organizations can operate as efficient information delivery systems to the many consumers who are interested in food quality.

This experience taught us many lessons and confirmed that education and information are broad-spectrum activities that need ongoing assessment to avoid the loss of focus and efficiency. Achieving GEC will require defining objectives while allowing flexibility for every programme and regional office of UNEP to realize them according to local realities.

In this way, GEC is seeking to play a significant role in facilitating the participation of major groups, including non-governmental organizations with international influence in regard to the environmental agenda. The idea is to enable actors to obtain information and capacities that will help them develop joint policies and practices on environmental issues of common concern.

GEC is developing alliances with groups whose members play important roles in society, such as parliamentarians, local authorities, consumers, educators, religious and ethical groups, and the print and electronic media. These groups will be consulted before public awareness activities are undertaken. Collaboration with these groups has already produced important results related to chemicals, trade and environment, and biosafety, among other issues.

GEC is therefore trying to increase the size and diversity of the audience which is concerned about global environmental issues by:

a) repackaging and adapting existing public awareness materials into formats which meet the needs and concerns of specific groups, with their contents corresponding to these groups' level of awareness and of capacity for action;

b) developing alliances with global networks which are interested in expanding the terms of reference of their constituencies to include global environmental concerns, and which have existing delivery systems that can be made available for the distribution of the materials generated by the programme.

The main thrust of GEC will be to generate actions in non-traditional constituencies by relating main environmental issues addressed in UNEP's agenda to their specific responsibilities, concerns, and interests. For example, in the case of parliamentarians, the programme could provide guidelines for preparing legislation/regulations, and help organize workshops/seminars.

The immediate objective of this programme is to assist a global environmental citizenry which wants to better understand its relationships and responsibilities in respect of global environmental goals, as prioritized by the international community, and to participate in actions which will make the attainment of these goals possible.

The GEC will work closely with the six key groups mentioned in order to generate public awareness and action in regard to some of the most important environmental issues. This will be achieved by improving the understanding of the relevance and linkages of these issues to local, regional and national environmental problems.

These groups already communicate via networks with effective delivery systems. They work in close coordination with citizen and community groups. The GEC intends to build innovative partnerships with these groups for the dissemination and implementation of public awareness activities whose purpose is to promote public policy and voluntary actions.

The activities and educational materials made available will be focused on the needs, concerns, level of awareness, and capacity for action of each type of recipient. They will be produced in user-friendly formats.

Parliamentarians

In general, parliamentarians have not taken part in the negotiation of key international legal instruments. However, they often participate when it comes to the implementation of such instruments. It is parliamentarians who develop the legal instruments which ensure the full incorporation of the content of Conventions (Climate Change, Biological Diversity, Basel Convention, CITES) and other international instruments in national regulatory frameworks.

In addition, parliamentarians may play a key role in approving budgetary allocations and in monitoring and assessing the actions taken by governments at national, regional or local levels. They need to be kept up-to-date on developments regarding global environmental issues and their linkages to actions in countries, at all levels.

Local authorities

The majority of projects which deal with environmental problems take place at the municipal or local level. Local authorities need to to understand the implications of the commitments made by national governments and of possibilities for participation in the formulation, implementation and monitoring of projects funded by international institutions. One of the networks identified by UNEP is the International Council for Local Environmental Initiatives (ICLEI), which comprises around 185 cities, counties, provinces and towns in 40 countries.

One GEC initiative will be the production of a tool kit for local authorities relating global environmental issues to local environmental problems (e.g. management of protected areas, energy efficiency in municipal heating, rural electrification, fuelwood supply, and transboundary problems among border municipalities), and encouraging their participation in internationally funded projects.

Consumer groups

Consumer groups play an important part in advocating environmentally sound practices such as energy efficiency and sustainable consumption, and in opposing unsound practices and products that damage the environment. These groups are increasingly being organized in both developed and developing countries. A GEC project will assist these groups in organizing effective public campaigns concerning, for example, water, energy efficiency and health problems that present in easily understandable terms the rights and responsibilities of consumers in relation to biodiversity, climate change, ozone layer depletion, and forestry and freshwater issues.

Educators

Educators can improve environmental literacy. Today, due to globalization, students are increasingly aware of planetary problems, including environmental ones. There is a need to improve their understanding of the importance of environmental issues and to better prepare them for the challenges of the future.

GEC will facilitate the identification and preparation of materials tailor-made to correspond to the level of awareness at different educational levels. These include printed material, videos, and tapes. The need for textbooks on global environmental issues at secondary and university levels will be identified.

Religious and ethical groups

The concept of environmental citizenship involves the recognition of rights and responsibilities in regard to health, well-being and dignity. Religious groups are among the principal transmitters of ethical values at all levels of society. Increasing their awareness of global environmental issues can promote voluntary environmental actions at the local or community level, and an informed interest in the global, national and regional environmental commitments of their countries.

A tool kit will be produced by GEC which relates religious teachings to the concept of global environmental citizenship.

Media

The print and electronic media play a basic role in education and the creation of public awareness. Journalists and TV reporters, for example, can help bring about social change and develop a well-informed environmental citizenry. There is an urgent need to reduce the complexity of the presentation of environmental issues, so that they will be easily understandable by a broader audience.

In respect of the print media, UNEP, through its publications *Our Planet* and *Tierramérica* has started a public communication campaign of great importance. The bi-monthly *Tierramérica* supplement is printed and distributed by a network of twelve prestigious newspapers in ten countries in Latin America with a readership of 4 million people. GEC will coordinate the inclusion in *Our Planet* and *Tierramérica* of coverage of global environmental issues in every supplement, and will endeavour to expand this type of print media activity worldwide.

For more information, contact Alicia Bárcena, Global Environmental Citezenship, UNEP Regional Office for Latin America and the Caribbean, Boulevard de los Virreyes No. 155, Col. Lomas Virreyes, 11000 Mexico, D.F. Mexico, Tel.: +52 (5) 202 6913/7493, Fax: +52 (5) 202 0950.

Alicia Bárcena, before joining UNEP, was the founder and Executive Director of the Earth Council.

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Consumers and the environment: meeting needs, changing lifestyles

Adapted from a presentation by **Erna Witoelar,**

President of Consumers International, on the occasion of the UNEP Governing Council meeting in Nairobi, Kenya, on 4 February 1997.

Consumers International (formerly IOCU, the International Organization of Consumer Unions) is a worldwide federation of some 214 consumer organizations in about 92 countries.

Environment is high on the agenda of the consumer movement.

Consumers' rights and responsibilities include the rights *to* a clean and healthy environment (besides the rights to safety, information, choice, satisfaction of basic needs, etc.) and responsibility *towards* the environment (i.e. understanding and acting upon environmental impacts).

The consumer movement had linked consumer protection and environmental concerns even before the Stockholm conference on the environment in 1972. Consumers are not only purchasers of goods and services, but also users of resources and, in their role as citizens, users of public goods and services. Hence they can be both victims and the cause of environmental degradation.

Consumer organizations play a large role in changing consumers from part of the problem into part of the solution. Through consumer education, research and testing, advocacy and campaigns, monitoring the enforcement of regulations, etc., consumers have organized to take action in regard to their environmental concerns. However, because these concerns were mainly related to the effects of environmental degradation, actions in the past were aimed more at defending consumers' rights than at fulfilling their responsibilities.

Developing countries, in particular, were still busy addressing problems like pesticide poisoning, lack of clean water, and air pollution – problems which still exist in both developing and developed countries – when their friends in the North began to implement ecolabelling and to campaign on the 4Rs (reuse, reduce, recycle, replace), etc. Overconsumption was not at first perceived as a problem for developing countries, which were naturally more concerned with underconsumption. The overconsuming lifestyles of these countries' fast-growing urban middle class consumers were overlooked, as the focus was on empowering rural consumers.

Since the publication of the UN's Brundtland Report, which called for the adoption worldwide of lifestyles "within the bounds of the ecologically possible and to which all can reasonably aspire", there has been a new wave of high-consuming lifestyles among the rich and middle classes in both developed and developing countries.

In market-based economies, goods and services are produced for consumption by those who have purchasing power. Structural adjustment programmes encourage this market-first approach to consumption. Therefore, developing countries (even where half or a third of the population is below the poverty line) have economic policies which favour more and better private cars over public buses, cellular phones over improved public communication systems, soft drinks over safe drinking water, golf courses over public sports facilities, and so on. Advertising does not promote only goods and services: it promotes high-consuming lifestyles.

Even though many consumer groups worldwide support sustainable consumption, individual or small-scale efforts are no longer effective. They are easily overwhelmed by aggressive global advertising and marketing. There is a greater need than ever to join forces – not only to link citizens globally but, equally importantly, to link their communications with governments and industry.

Business should take into account the consumption patterns it promotes through advertising and marketing. Some social audits are starting to take this important aspect into account. Government control and regulatory functions such as "green" taxes or other penalties for polluting industries, however reluctantly practised due to "free market" pressures, need to be implemented. Governments also need to encourage sustainable practices and discourage unsustainable ones by reducing subsidies to agriculture that uses large amounts of chemicals and providing incentives to use more durable products and to implement reuse/recycling systems, etc.

Massive communication, education and training programmes are also needed. Their aim should be to change the value attached to high consumption. Moving towards sustainable lifestyles will require a major shift in the prevailing economic logic, which assumes that happiness and the good life depend on increased consumption.

Consumers have purchasing power. They need to be aware that they can influence the market. In order to exercise this power, however, they need information on environmental impacts. Independent assessment (e.g. of energy efficiency) of key products is essential in mobilizing consumer action. Consumer boycotts can be quite effective if employed wisely and strategically. Several such boycotts, especially those led by women consumers, have brought about changes in some countries. Consumer education, beginning in schools, is essential to promoting consumer responsibility and helping consumers make informed choices.

In 1995, the UN Commission on Sustainable Development decided to expand the 1985 UN Guidelines for Consumer Protection to include a guideline on sustainable consumption. During its 1996 session, it asked Consumers International and its members to assist the UN and its member governments in this task. Consumers International prepared a draft guideline which will be on the 1998 agenda of ECOSOC (United Nations Economic and Social Council). We look forward to its adoption.

In conclusion, we must work together towards sustainable consumption which will meet the needs of those who are still underconsuming, and towards changing the lifestyles of those who are overconsuming. After all, we are all consumers, whatever our gender, whatever our age, and whatever our positions and functions.

The European Union Eco-label scheme: an environmental policy marketing tool

Marco Loprieno, European Commission – Directorate E, Industry and Environment, XI.E.4, Rue de la Loi 200, B-1049 Brussels, Belgium

Abstract

Council Regulation (EEC) N° 880/92 of 23 March 1992 established a European ecolabelling award scheme under which products in conformity with specified criteria aimed at ensuring a high level of environmental protection over the products' entire life cycle could be awarded an ecolabel on request from manufacturers or importers. The objectives of this scheme are to promote the design, production, marketing and use of products with reduced environmental impact during their entire life cycle, and to provide consumers with better information on products' environmental impact. The scheme, which is entirely voluntary, is a market-oriented instrument within the framework of EU environmental policy.

Résumé

Le règlement européen (CEE) n° 880/92 du 23 mars 1992 met en place un programme d'écolabellisation selon lequel les produits conformes à certains critères destinés à garantir un niveau élevé de protection de l'environnement pendant la totalité du cycle de vie des produits pourraient, à la demande des fabricants ou des importateurs, recevoir un label écologique. L'objectif est de promouvoir la conception, la production, la commercialisation et l'utilisation de produits ayant un impact minimum sur l'environnement pendant toute leur durée de vie, et de mieux informer les consommateurs de l'impact des produits sur l'environnement. Ce programme, auquel chacun est libre d'adhérer ou non, est un instrument orienté vers le marché qui s'inscrit dans le cadre de la politique européenne en matière d'environnement.

Resumen

El Reglamento del Consejo (CEE) N_ 880/92 del 23 de Marzo de 1992, estableció un sistema de asignación de etiquetado ecológico europeo por el cual los productos, conformes a un criterio específico destinados a proporcionar un alto nivel de protección medioambiental a lo largo de todo el ciclo de vida de los mismos, podrían obtener una etiqueta ecológica ante el pedido de los fabricantes o importadores. Los objetivos perseguidos por tal sistema son promover el diseño, la producción, el marketing y uso de productos con un impacto medioambiental reducido durante todo su ciclo de vida y suministrar a los consumidores una mejor información sobre el impacto medioambiental de los productos. El sistema, que es totalmente voluntario, es un instrumento orientado hacia el mercado dentro del marco de la política medioambiental de la UE.

The EU Eco-label scheme and sustainable consumption

The overall objective of European Union policy on environment and industry is to contribute to sustainable development. The EU Eco-label scheme, as laid down in Council Regulation (EEC) N° 880/92,[1] is well in line with the principles, goals and priorities selected by the Fifth Community Environmental Action Programme and its Review, as well as with Agenda 21.

The scheme is part of a broader strategy aimed at promoting sustainable production and consumption. This aim can be achieved in the context of a "framework for an integrated life cycle oriented product policy", as indicated in the proposed Decision on the Review of the Fifth Environmental Action Programme.[2]

Being a so-called "market-based instrument", the primary function of the EU Eco-label is to stimulate the supply and demand of products with a reduced environmental impact. With respect to supply, the EU Eco-label has a clear objective of encouraging industry to market greener and certified products. On the demand side, the scheme gives consumers the means to make informed environmental choices when purchasing.

The measure to "provide guidance to consumers" has considerable implications with regard to economic efficiency. In fact, the Eco-label could reduce costs for consumers and retailers by reducing the time and effort needed to obtain and provide information. At the same time, products eco-labelled in the EU scheme can give the guarantee to the public that their compliance with established ecological criteria has been tested by independent third parties.

Information, as it is used by the scheme, is the main characteristic of a market-based environmental policy. Diffusing information about the environmental effects of a product during its whole life cycle will be essential in order to support sustainable consumption.

Main elements of the scheme

First of all, the scheme is *selective*. The label is awarded only to those products with the lowest environmental impact in a product range. Product categories are carefully defined, so that all products that have direct "equivalence of use" as seen through the eyes of the consumer are included in the same product group. For instance, a recent study on possible Eco-label criteria for rubbish bags is examining at the same time the two main sub-categories: paper and plastic rubbish bags.

The European Commission develops ecological criteria for product groups in close collaboration with Member States. Indeed, the Commission cannot adopt criteria before environmental experts have given their opinion by voting in the Eco-label Regulatory Committee by qualified majority.

Transparency and widespread participation are further enhanced by the considerable input of representatives of industry, commerce, environmental and consumer organizations and trade unions. Article 6 of Regulation 880/92 stipulates how these European-level interest groups are consulted within the framework of the Eco-label Consultation Forum. At present, non-European manufacturers are represented by the organization Eurocommerce. The final consumer, therefore, should recognize that the Eco-label logo represents ecological criteria which have been established according to scientific and technical guidelines, with widespread participation from independent and neutral bodies.

The use of a *multi-criteria* approach is the other distinctive characteristic of the EU scheme. Ecological criteria are not based on a single parameter, but rather rest on a study which analyses the impact of the product on the environment throughout its entire life cycle, possibly starting from raw material extraction in the pre-production stage, through production, distribution and use of the product, to the disposal of the product.

A further strength of the label is its *European dimension*. A manufacturer who meets the criteria for a product group and who decides to apply for the award of the Eco-label can, if successful, market his eco-labelled product throughout the 15 Member States of the European Union and in those countries which are signatories to the EEA Agreement. This avoids having to make an application in every country where a national label exists and thus avoids time-consuming and costly procedures. The same logo will also be used regardless of the product group in question, thereby eliminating consumer confusion prevalent at the moment given the numerous logos in existence.

The European Eco-Label Award Scheme is *voluntary.* The scheme is not establishing ecological standards which all manufacturers must meet. It is for the producer to decide whether or not to apply once the criteria are published in the *Official Journal.* Given the underlying rationale of the scheme, to put market pressure on the manufacturer, the success of the scheme would offer a considerable market incentive for manufacturers to switch to clean technology and to research and innovate in that direction. The voluntary nature of the scheme means that it does not create barriers to trade. Foreign and Community producers may sell products within the EU markets without the EU Eco-label.

Applying for the Eco-Label: Each Member State of the EU has to designate a Competent Body which is responsible for receiving applications from manufacturers or importers for the award of the Eco-label to their products. The Competent Body decides on standard application forms with explanatory notes based on the product group definitions and ecological criteria which have been previously adopted. Each decision to award an Eco-label to an individual product must first be cleared with the Competent Bodies in all Member States (during a 30-day period). This clearance ensures the ability of a successful applicant to enjoy Community-wide recognition of his Eco-label award.

A successful applicant is required to sign a contract with the Competent Body for the use of the Eco-label for the remaining period of validity of the ecological criteria. The Competent Body charges a 500 ECU fee for the application. At present, with respect to the annual use of the label, the company applying has to pay 0.15 per cent of its annual volume of sales for the eco-labelled product in the European Union.

The *award of the Eco-label* means that successful applicants are permitted to use the official flower logo on their approved product. Thus a consumer in a supermarket who is faced with a line of different brands of laundry detergents (for instance) will be able to pick out, by checking the Eco-label logo, the one or two which achieve a high standard of environmental performance compared with the rest of the field.

Procedural guidelines for development of EU Eco-labels

In practice, the functioning of the Eco-label scheme consists of three general phases: the establishment of criteria, the award of the label to products and the revision of the criteria. Whereas responsibility for establishing and revising the criteria lies mainly with the Commission, the award of the label to products is a matter for the National Competent Bodies. These Competent Bodies, which are independent and neutral, have been designated by the Member States to implement the Community Eco-label scheme at national level.

The initiative for selecting a group of products is taken either by the Commission or by the Competent Bodies. In the initial stage of the operation of the Community scheme, priority was given to the latter possibility. More recently, the Commission has assumed greater responsibility for selecting groups of products. This is in line with the wishes of the Member States and the interest groups for greater consistency in the application of the scheme. The interest groups, i.e. industry, commerce, consumer organizations, environmental protection organizations and trade unions, are consulted on the choice of product groups.

A feasibility study is carried out to collate data on the following aspects: the market structure, the interests of the parties concerned, the relevance and potential benefits of the label for the environment, the risks of distortion between the various national segments of the internal market and, finally, international aspects. An *ad hoc* working group composed of experts from the Member States and representatives of all the parties concerned evaluates the feasibility study. On the basis of these results, a complete analysis of the life cycle of the group of products is made. This study comprises a market study, an inventory and evaluation of the environmental impact of the group of products, and a proposal for criteria.

The proposal for ecological criteria is officially presented to the Consultation Forum provided for in the Regulation for consultations with the different interest groups. The proposal is discussed and voted upon in a Regulatory Committee. A formal Decision by the Commission concludes the adoption procedure.

Under the Regulation, the Competent Bodies are responsible for awarding the label. A summary of each application is circulated to all the Competent Bodies, whereas the complete dossier on the evaluation of the product is sent only on request.

Methodology: LCA and Eco-label procedures

According to Articles 1 and 5 (4) of Regulation 880/92, the EU Eco-label scheme is based on the so-called "cradle-to-grave" approach. The criteria to be set for each specific product group (e.g. copying paper, indoor paints and varnishes, etc.) should be based on the consideration of the environmental impacts in all the life stages of the products considered. The methodology used to study the environmental impact of product groups is Life Cycle Assessment (LCA).

The Regulation just sets a framework for the functioning of the Community Eco-label. The scheme can only be applied to products for which ecological criteria have been established by the Commission in accordance with the principles and procedures of the Regulation. The entry into force of the Regulation in 1992 was therefore only a starting point for the preparatory work for the actual launch of the scheme. The period since the entry into force of the Regulation has mostly been devoted to establishing product groups and the corresponding ecological criteria.

The considerable amount of work behind the definition of the different product groups allowed a constant refining and improvement of the LCA methodology and a better understanding of its role with regard to the policy framework.

One of the main characteristics of the relationship between LCA and the EU Eco-label scheme is certainly the "work in progress" and "learning by doing" approach. As the *Groupe des Sages* defined it: "LCA...is a methodology still in the process of development, requiring additional research and systematic data collection. Therefore policy makers, competent bodies and practitioners must remain aware of the current capabilities and limitations of LCA and should support its continuous development."

In order to ensure consistency, effectiveness and sufficient quality of the criteria setting process, it has been necessary to define a six-phase procedure based on the "Procedural Guidelines for the Establishment of Product Groups and Ecological Criteria", which was agreed between the Commission services and the Competent Bodies of the Member States. The different phases are: feasibility study; market study; inventory; environmental impact assessment; setting of criteria; and presentation of a draft proposal for a Commission Decision.

The preparatory work for the setting up of the Procedural Guidelines started in December 1993, when the Commission established the so-called *Groupe des Sages* to advise on the methodological implications of using LCA in the general framework of the Eco-label. The *Groupe des Sages* produced three reports. The main themes of their research were summarized in the key recommendations of the first report, where the relationship between LCA and analysis of the market conditions and innovation was already clear: "Life Cycle Assessment can make a significant contribution in providing a scientific, unifying and transparent basis for the EU Ecolabelling programme. It is central to this programme because it compares different products on the basis of their common function. It relates environmental impacts, at all stages from cradle to grave, to both market changes and technology improvements."

The *Groupe des Sages* played an important role in fitting the LCA methodology established at international level by SETAC, the Society for Environmental Toxicology and Chemistry, and ISO, the International Organization for Standardization, within the context of the EU Eco-label. Therefore, the objectives of the guidelines set by the *Groupe des Sages* have been extremely useful in supporting the EU Member States and the Commission in establishing Eco-label criteria based on a scientifically sound and practicable methodology. Moreover, the methodological guidelines have improved the uniformity in the methods applied in different Member States.

The work of the *Groupe des Sages* has been instrumental in clarifying the distinction between the decision-making phases and the proper LCA study – in other words, between the policy aspects, the proposal of the key ecological criteria, and the scientific analysis on which the LCA is based. "LCA is only a decision support tool; it cannot replace actual decision making." The policy aspects were stressed by internal guidelines agreed between the Commission and the Eco-label Competent Bodies, which have constituted an indispensable reference point for the development of principles to be complied with in the establishment of product groups and ecological criteria.

Revision of the Eco-label scheme

Despite the fact that the Community scheme has recently made substantial progress (Eco-label criteria have now been published for twelve product groups and the Eco-label has been awarded to 160 products), certain difficulties have been encountered in the implementation of the Regulation. Using the experience gained in the implementation of the Regulation over four years, the European Commission has concluded that there is a need to improve and streamline the approach, methodologies and working procedures of the scheme in order to increase its effectiveness, efficiency and transparency. On 10 December 1996, to begin the process of improvement, the Commission adopted a Proposal to revise Council Regulation 880/92 establishing a Community Eco-label Award Scheme.

The basic aims of the scheme still hold, i.e. providing guidance to consumers on products with a potential to reduce environmental impacts in a life cycle perspective and provide information on the environmental characteristics of labelled products.

The new scheme will clarify the indication to consumers of those products which have the potential to reduce certain environmental impacts. The scope of the scheme should include products and environmental aspects which are of priority interest within the EU.

The procedural and methodological approach for setting Eco-label criteria should be updated in the light of scientific and technical progress and experience gained, and to ensure consistency with internationally recognized standards which are developing in this area. The principles for establishing the selectivity level of the eco-label should be clarified in order to facilitate consistent and effective implementation of the scheme. It should include simple, accurate, non-deceptive and scientifically based information on the key environmental aspects which are considered for the awarding of the label, in order to enable consumers to make informed choices.

Under the proposed revision, the ecological criteria would be developed by the European Eco-labelling Organisation (EEO). Its *modus operandi* will be based on the principles of the "new approach" for harmonization of technical standards, introduced by the Commission in 1985. The EEO will be a private organization with a small secretariat, linking in a network the already existing national Eco-label Competent Bodies, who are active players in the running of the scheme. The objective of delegating to the EEO the establishment of Eco-label criteria is to "privatize" the operation of this scheme while maintaining its "Community" nature.

A further important modification will be the introduction of a ceiling for the fees payable for using the label. At present there is a 0.15 per cent open-ended royalty figure for the use of the label, depending on the volume of sales. In future the

Eco-label: competent bodies and contact points in Europe

Denmark:
Ms Anne Nielsen
Ministry of the Environment and Energy
Danish Environmental Protection Agency
Strandgade 29
DK - 1401 Copenhagen K
tel: (+45-32) 66.01.00
fax: (+45-32) 66.04.79
mst@mst.mst.dk

Luxembourg:
Mr Henri Haine
Ministère de l'Environnement
18, Montée de la Petrusse
L - 2918 Luxembourg
tel: (+352) 478.68.16
fax: (+352) 40.04.10

The Netherlands:
Mrs Ineke Giezeman
Stichting Milieuke
Eisenhowerlaan 150
NL - 2517 KP 's-Gravenhage
tel: (+31-70) 358.63.00
fax: (+31-70) 350.25.17

Germany:
Mr Georg Maue
Umweltbundesamt (FG III 1.3)
Seeckstr. 6-10
D - 13581 Berlin
tel: (+49-30) 8903.30.17
fax: (+49-30) 8903.30.99
maue@uba.de

Mr Henning Scholtz
RAL, Deutsches Institut für Gütesicherung und Kennzeichnung
Siegburger Str. 39
D - 53757 Sankt Augustin
tel: (+49-22-41) 16.05.23
fax: (+49-22-41) 16.05.11

Austria:
Mr Thomas Jakl
Bundesministerium für Umwelt
Stubenbastei 5
A - 1010 Wien
tel:(+43-1) 515.22.27.09
fax: (+43-1) 515.22.76.49

Greece:
Mrs Amalia Katsoy
Ministry of Environment, Physical Planning and Public Works
17 Amaliados Street
GR - 115-23 Athens
tel: (+30-1) 641.17.17/ 642.65.31
fax: (+30-1) 643.44.70

Portugal:
Mrs Delfina de Serpa Pinto
Direçao Geral da Industria
Av. Conselheiro Fernando de Sousa, 11
P - 1099 Lisboa
tel: (+351-1) 385.91.61
fax: (+351-1) 383.10.42

Spain:
Mr José Luis Tejera
Asociación Española de Normalización y Certificación (AENOR)
C/. Génova 6
E - 28004 Madrid
tel: (+34-1) 432.60.00
fax: (+34-1) 319.05.81

Mr Salvador Samitier i Marti
Direcció General de Qualitat Ambiental
Departament de Medi Ambient
Generalitat de Catalunya
Av. Diagonal, 523-525
E - 08029 Barcelona
tel: (+34-3) 419.30.85
fax: (+34-3) 419.76.30

Finland:
Mrs Leena Nyqvist
Finnish Standards Association SFS - Environmental Labelling
P.O. Box 116
FIN - 00241 Helsinki
tel: (+358-9) 14.99.33 91
fax: (+358-9) 14.99.33.20
leena.nyqvist@sfs.fi
http://www.sfs.fi/

Sweden:
Mrs Kerstin Sahlén
SIS Eco-Labelling
P.O. Box 6455
S - 113 82 Stockholm
tel: (+46-8) 610.30.45
fax: (+46-8) 34.20.10
kerstin.sahlen@sis.se

France:
Mme Patricia Proia
Association Française de Normalisation (AFNOR)
Tour Europe Cedex 7
F - 92049 Paris La Défense
tel: (+33-1) 42.91.59.26
fax: (+33-1) 42.91.56.86
patricia.proia@email.afnor.fr

United Kingdom:
Mr Michael Jones
UK Ecolabelling Board
Eastbury House
30-34 Albert Embankment
UK - London SE1 7TL
tel: (+44-171) 820.11.99
fax: (+44-171) 820.11.04
michael.jones@ukeb.demon.co.uk

Ireland:
Mr William Burns
National Standards Authority of Ireland (NSAI)
Forfas, Glasnevin
IRL - Dublin 9
tel: (+353-1) 807.38.89
fax: (+353-1) 807.38.38
burns@nsai.ie

Norway:
Ms Marianne Eskeland
Norwegian Foundation for Environmental Product Labelling
Kristian August Gate 5
N - 0164 Oslo
tel: (47-22) 36.07.10
fax: (+47-22) 36.07.29
competent.body.norway@ecolabel.no

Italy:
Mr Raffaele Scialdoni
ANPA
Via Vitaliano Brancati, 48
I - 00144 Roma
tel: (+39-6) 5007 2077
fax: (+39-6) 5007 2048
ecolabel@anpa.it

Iceland:
Mr Tore Skjenstad
Environmental and Food Agency
P.O. Box 8080
IS - 128 Reykjavik
tel: (+35-4) 568.88.48
fax: (+35-4) 568.18.96
tore@hollver.is

Contact point in other Member States

Belgium:
Ms Marleen Van den Brande
Ministerie Volksgezondheid en Leefmilieu
Rijksadministratief Centrum
Vesalius 4
Pachecolaan 19, bus 7
B -1010 Brussels
tel: (+32-2) 210.46.80
fax: (+32-2) 210.48.73

Contact point in the European Commission

Mr Graham Morrison
DG XI.E.4
European Commission
Rue de la Loi 200
B-1049 Brussels
tel: (+32-2) 299.03.96
fax (+32-2) 295.56.84
graham.morrison@dg11.cec.be

maximum fee will be 40,000 ECU, whatever the sales on the EU market. Moreover, the rate of fees will be reduced to 0.10 per cent in the case of SMEs and manufacturers from developing countries.

An additional objective of the Revision is the introduction of a graduated label to ensure the possibility of communicating more information to consumers regarding the key ecological criteria. Moreover, the grading of the scheme will be important in order to stimulate and recognize further environmental improvements above the hurdles set out for the award of the label.

Another important measure is to ensure better coordination between the EU scheme and the existing national schemes in the Community, to avoid confusion for consumers and potential market and trade distortions. The final harmonization for those product groups which are important at European level will increase the attractiveness of the Eco-label for manufacturers.

Finally, special attention will be given to improving the transparency of the scheme in order to ensure consistency with relevant international standards to facilitate access and direct participation of manufacturers and exporters of countries not in the EU. The market value of the EU Eco-label will be further enhanced by the possibility for retailers to apply for those products marketed under their own brand name.

The proposed Revision will be presented to the Council and the opinion of the European Parliament, the Economic and Social Committee, and the Committee of the Regions will also be sought. Deliberations will be held throughout 1997. In the meantime, the current Regulation will continue to operate in its present form until the Revision is formally adopted by the Council.

The EU Eco-label scheme: a growing environmental marketing instrument

The existing EU Eco-label award scheme has been in operation since 1993, when the first product groups were established, and it has recently (May 1997) made substantial progress. Eco-label criteria have been now published for *twelve product groups*. Commission Decisions establishing ecological criteria have so far been adopted and published for: washing machines, dishwashers, soil improvers, toilet paper, paper kitchen rolls, laundry detergents, single-ended light bulbs, indoor paints and varnishes, bed linen and t-shirts, double-ended light bulbs, copying paper and refrigerators.

So far, 36 "licences" for the use of the logo have been granted to 18 manufacturers and one importer, for a total of *160 products*. The geographical spread of the awards is wide, with successful applications in Denmark, Finland, France, Ireland, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Only one year ago there were fewer than 20 products eco-labelled with applications in only three countries (France, Sweden and the UK).

It is certainly too early to assess the consumers' response and the users' perceptions and reactions. However, the very encouraging reactions from manufacturers in recent months show that the dynamics of supply and demand in a free market are working to the advantage of firms applying for the EU Eco-label. The steady increase in the number of applications from manufacturers will continue, as both they and consumers realize the importance of this little flower and the benefits it brings.

Commissioner Ritt Bjerregaard has said that the proposed revised Eco-label scheme "*...will be an important market-oriented instrument in the EU's environment policy*" and that it "*...will make it easier for the 373 million European consumers to make their choice for 'green' products by clearly indicating the positive environmental impact of the product. Consumers also have the choice to disregard products which do not carry the Eco-label, thereby putting pressure on producers to apply for the label and change production patterns in order to live up to the criteria of a reduced impact on the environment.*"

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Eco-labelling in the textile industry

Brian Burdett, Executive Manager, BTTG, Shirley House, Wilmslow Road, Didsbury, Manchester M20 2RB, UK

Abstract
There are many textile eco-labels in Europe, all of which are voluntary. The methods of testing are based on well known standards. In addition to the EU eco-labelling scheme, there are both national and "private" schemes. The EU label has yet to make an impact on the textile industry, but GuT and Öko-Tex, the two leading European private schemes, are having an impact on production and disposal.

Résumé
il y a de nombreux écolabels pour les textiles en Europe, tous volontairement adoptés. Les méthodes d'évaluation sont basées sur des normes bien définies et connues. Outre le programme d'écolabellisation de l'Union européenne, il existe des programmes nationaux et des programmes "privés". Tandis que le label de l'Union européenne ne s'est pas encore vraiment imposé dans l'industrie textile, GuT et Öko-Tex, les deux principaux programmes européens, ont un impact certain sur la production et l'élimination à la fin de cycle de vie des produits.

Resumen
Existen muchas etiquetas ecológicas en el sector textil europeo, todas ellas son voluntarias. Los métodos de evaluación están basados en normas de renombre. Además del sistema de etiquetado ecológico de la Unión Europea, existen ambos sistemas, nacionales y "privados". La etiqueta UE debe todavía debe abrirse camino en la industria textil, pero GuT y Öko-Tex, los dos principales sistemas privados europeos están teniendo una gran influencia en la producción y los desechos.

Introduction

For some years now, environmental issues have been gaining ground in regard to all aspects of industrial production. There is also a growing trend for the general public to recognize the need for environmental protection. The philosophy throughout Europe is to improve processes along the entire production chain from raw material to final product, and then to be aware of the environmental implications of product disposal. Many projects, schemes and organizations within Europe have as their aim the improvement of environmental technology and standards.

Eco-labelling is a philosophy and way of life that is continually increasing in importance in Europe. Consumer associations insist on positive declarations on eco-labels, particularly for textile materials, and on information about the substances used in fabrics or garments. Emphasis is placed on human ecology – in other words, the possible harmful effects of the final merchandise, particularly clothing, on the human body.

Within Europe there are many textile eco-labels; some are national, while others are so-called "private" labels which cover a wider geographical area. This terminology distinguishes them from EU eco-labelling. Currently, the private labels are:

- Ecotex, which is based on the auditing and analysis of products and processes;
- Öko-Tex, which carries out tests on the finished product;
- GuT, which is essentially a life cycle analysis protocol.

The national labels are:

- Nordic Swan (Norway, Sweden, Finland, Iceland), a life cycle analysis protocol;
- The Swedish Nature Conservation Society, which does not analyse the final product but requires detailed descriptions of fibre production and textile manufacture;
- Skal Organic (the Netherlands), which monitors the whole production process for products made only of organically produced natural fibres.
- Stichting Milieukeur (Netherlands), a protocol for fabrics designed to be used in clothing and/or the clothing itself which monitors each step in the production chain and analyses the finished product. The Skal and Öko-Tex awards can be used to obtain the *Milieukeur*.

This list of seven labels represents three different approaches. The first is based on a series of relevant, albeit costly, tests of the finished product and may be considered as a guarantee of consumer health and safety. The Öko-Tex label is perhaps the most advanced in this respect. The second approach is based on environmental auditing and an analysis of the products and processes, and is closer to both industry and the environment. The Ecotex label is well advanced in this respect. The third and most complete approach is based on a life cycle analysis of the product. It is the approach used in the GuT scheme and is also built into the EU policy for eco-labels.

This fragmentation, and obvious confusion, have occurred because of the absence of a single European eco-label for textile products. The delay in achieving a single European label is partly due to pressure groups pursuing their own philosophies concerning environmental issues, as indicated above.

The two leading schemes within Western Europe are GuT and Öko-Tex. The former, *Gemeinschaft umweltfreundlicher Teppichboden*, the Association for Environmentally Friendly Carpets, was founded in 1990 by leading companies in the carpet industry and now has 87 members. It is supported by 47 associate members, which are mainly suppliers to the carpet industry. About 75 per cent of European carpet manufacturing comes under the auspices of this association.

Öko-Tex, *Internationale Gemeinschaft für Forschung und Prüfung auf dem Gebiet der Textilökologie*, International Association for Research and Testing in the Field of Textile Ecology, was also formed in 1990. There are twelve Öko-Tex Test Institutes in Western Europe. To date, over 500 companies have participated in the scheme and about 3000 Öko-Tex certificates have been issued.

In countries outside the EU, eco-labelling policies are being formulated but textiles and clothing are not necessarily included. For example, the Czech Republic has its own eco-labelling policy, but textiles are not included in the product list. However, the Czechs wish to merge their policy with that of the EU.

The EU eco-labelling scheme

The European Community launched its official ecological labelling policy in March 1992. This policy is based on the product's impact on the environment during its entire life cycle, otherwise referred to as the "cradle-to-grave" approach. It is a commitment to the welfare of the environment and can be summarized by its objectives, namely:

- to promote the design, marketing and use of products which have a reduced environmental impact during their entire life cycle, and
- to provide consumers with better information on the environmental impact of the products without, however, compromising product or worker safety or significantly affecting the properties which make a product fit for use.

The EU eco-labelling scheme is voluntary. It is administered by a Competent Body within each Member State which is responsible for awarding certificates. In the UK, the Competent Body is the UK Eco-labelling Board, set up by the Department of Trade and Industry.

A significant feature of the scheme is the emphasis placed on the life cycle analysis of a particular product. It should be noted that the scheme is applicable to a product or products, not to the manufacturers of the products. Once an eco-labelling scheme has been established for a product, the standards and protocol for that product will be revised only after a period of three years.

Since the eco-labelling Regulation was published, only twelve products have completed the formidable scrutiny necessary to achieve an EU eco-label: washing machines, dishwashers, kitchen towels, toilet paper, soil improvers, single-ended and double-ended light bulbs, paints, varnishes, detergents, copying paper, T-shirts and bed linen. A number of other products are still in the preparatory stages.

Textile labelling criteria have been adopted for two pilot textile products: T-shirts and bed linen manufactured from cotton or cotton/polyester blends. Unfortunately, progress on the EU label has been very slow, resulting in emphasis being placed on national and private labels. This protocol must function satisfactorily before being extended to other textile products. However, the success or failure of the scheme will ultimately depend on market forces and the commercial value of the label.

The criteria for monitoring textile products must be seen to be sensible and practical. Otherwise, the label will not be accepted by the industry. In setting up the eco-label for T-shirts and bed linen, the issues in **Table 1** were discussed.

During the manufacture of polyester fibre, valuable raw materials will be irretrievably lost as a future resource unless there are advances in the recycling of textile materials in general and of polyester products in particular. Cotton is a natural fibre, but there is high usage of agrochemicals and pesticides during fibre production. Depending on the source of information, 10-25 per cent of all pesticides used in the world go into cotton production. There is increasing interest in organically grown and natural, inherently coloured cotton for which, so far, a premium can be asked. Further environmental issues are raised in quantifying energy and water consumption, not only during the manufacture of the merchandise but also during use. Here environmental trade-offs, or balances, need to be addressed. For example, in using resin treatments to obtain a crease-resistant finish there is a lower usage of water and energy in the domestic situation than would be the case if no treatment were given. If the latter, then the use of formaldehyde, a ubiquitous and contentious chemical, would not be necessary.

Use of chemicals, including dyes, during manufacture and their retention by the textile material is important in relation to human ecology. What are the possible harmful effects of the final merchandise, particularly clothing, on the human body? If particular dyes and chemicals are known to cause harmful effects, limits on, or avoidance of, their use must be specified. In the schemes now in effect or under discussion, certain chemicals are not to be detected while others may be present below certain defined levels of concentration.

Disposal occurs at the end of the product's life cycle. The method and consequences of disposal are just as important as the other stages. The disposal ecology of textiles encompasses recycling, reuse, non-hazardous decomposition, and safe burning without air pollution, together with recovery of the energy generated. In all instances, pressure is increasing for knowledge of the characteristics of the dyes used in the product so that disposal can be controlled.

Table 1
Important issues in relation to textiles

Use of irreplaceable raw materials
Use of agrochemicals and pesticides
Energy, water and chemicals used during manufacture and life of the product
Packaging
Human ecology
Performance specifications
Disposal

Table 2
Criteria for eco-labelling of textiles

Fitness for use
Tests on materials and the final product
Consumption of energy
Consumption of water
Emissions to the environment
Wastewater discharges
Restrictions on the use of chemicals
Occupational conditions

Table 3
GuT product tests

1	**Contaminant Testing**	
	Volatile fluorinated hydrocarbons	
	Azo dyes having carcinogenic amine content	
	Asbestos	
	Dye carriers	
	Pentachlorophenol	
	Formaldehyde	
	Hazardous pesticides	
	Butadiene	
	Vinyl chloride	
	Vinyl acetate	
2	**Emission Testing**	
	Toluene	50 mg/m^3
	Styrene	5 mg/m^3
	4-Vinylcyclohexane	2 mg/m^3
	4-Phenylcyclohexane	20 mg/m^3
	Total aromatic hydrocarbons	150 mg/m^3
	Total volatile organic substances	300 mg/m^3
3	**Odour Testing**	

Table 4
Environmental monitoring of each site

1	**Off-air Emissions** Organic gaseous substances Inorganic gaseous substances Dust and dust-borne substances
2	**Wastewater Pollution** Chemical Oxygen Demand (COD) Biological Oxygen Demand (BOD) Adsorbable organic halogen compounds (AOX) Hydrocarbons Heavy Metals
3	**Quality of the Raw Materials**

The overall criteria that need to be addressed are shown in **Table 2**.

Eco-labels are not quality labels. However, for an article to achieve eco-label status, it must be manufactured under strictly controlled conditions in order to pass the standards laid down in the criteria. As far as textiles are concerned, fitness for use refers to the necessary fastness assessments of the final product. Tests include those for heavy metal content and residues, formaldehyde, organic chlorine, pH, and carcinogenic aromatic amines. Restrictions are placed on the use of certain chemicals, for example pesticides, sizes, bleaching agents, dyes and finishes. Submission of calculations of energy and water used during the manufacture of the textile is voluntary. However, the data provided will be used by the Commission to set additional guidelines for the use of energy and water when the criteria are reviewed in 1999.

The GuT scheme

The objectives of the GuT scheme are similar to those already noted for the European one, namely:

◆ to provide products that are manufactured in an environmentally compatible manner;
◆ to promote consumer welfare; and
◆ to optimize the life cycle of the product.

Within the scheme emphasis is placed not only on testing the carpet product, but also on the site of manufacture and, of no less importance, the whole life cycle, including disposal.

For a manufacturer to receive the GuT Signet, the product must be tested in accordance with approved methods and the site must have been audited for compliance not only with GuT standards but also with local legislation.

Product testing for certification is divided into three sections: contaminant testing, emission testing, and odour testing (**Table 3**). Depending on the carpet construction and methods of manufacture, this is a very comprehensive set of tests. Site monitoring, which takes place once every three years unless special circumstances dictate more frequent testing, is no less exhaustive. The testing areas are indicated in **Table 4**. The contaminants listed in Table 3 must not be used in the manufacture of the product or must not be detectable in the product. Although carpets are not in the context of MAK amines classified as consumer goods, GuT members have agreed to ban the use of the appropriate azo dyes.

To comply with emission testing, the results must fall below the threshold values shown in Table 3 for individual constituents and/or cumulative totals. To assist carpet manufacturers to achieve these tolerance limits, latex manufacturers are themselves subjecting their products to GuT testing.

Carpets containing wool can only be granted the GuT Signet as long as that fibre has been subjected to a mothproofing treatment. Admissible mothproofing agents are those which contain permethrin, cyfluthrin or sulcofuron as their active ingredient. The permitted maximum amounts allowed to be present on the final product are: permethrin plus cyfluthrin, 210 mg/kg wool; sulcofuron, 4000 mg/kg wool.

As a consequence of this close scrutiny of the details of the product and of the site, the consumer can be reassured concerning a number of health and ecological issues:

- Routine monitoring ensures that the product is manufactured by environmentally compatible methods;
- Certain chemicals are banned from use, so that product testing guarantees that the products do not contain any hazardous substances,
- Certain other chemicals that are allowed to be present must be below specified tolerance limits; and
- Unusual odours must not be present.

With the presentation of each GuT Signet there is an individual test number, so that in the event of a complaint the details of the product and the test results can be traced to the appropriate test laboratory (**Table 5**). As a further indication of GuT's attention to product manufacture, 15 per cent of a manufacturer's certified articles are subjected to control tests each year. The samples used for examination can be taken from current production or purchased.

The fact that GuT is an association governed by its members enables binding decisions to be made on changes in its procedures and in the life cycle of the product.

For example, metal-containing chemicals, including metal-complex dyes, which are commonly used in the carpet industry have been closely scrutinized. In certain circumstances the heavy metal content of residual liquors could give rise to environmental problems, and the metal content of the carpet product could cause difficulties in the recycling or incineration of the waste. As a result of the work of the Dyeing Group, and despite persistent technical difficulties, members have voluntarily banned the use of dyes and auxiliaries that contain lead, cadmium, mercury or chromium-VI. This decision means that acid dyes must be more widely used, giving rise to increased production costs and, in some instances, to colour and fastness restriction, particularly in regard to light and shampooing. In certain instances problems will occur, for example in rooms with high light intensity or intense ultraviolet irradiation.

Increases in waste management costs have resulted in project work in this sector being intensified. Throughout Europe, about 900 million square metres (1.5 million tonnes) of textile floor coverings are discarded, and landfill costs are averaging £120 per tonne of waste and continue to rise. It is no wonder that, besides the emphasis on quality, GuT members are increasingly concerned with the problem of disposal. Traditional methods have no future. GuT members are progressively abandoning the practice of disposal to landfill. Instead, work is emphasizing combustion with energy recovery, recycling, and the logistics of waste management.

Textile floor coverings have an energy content comparable to that of coal, and thus represent a significant source of energy. Heat recovery from all conventionally manufactured carpets is feasible from ecological, technological and economic points of view. Emissions are low, and the ash residue presents no problems. Recycling cannot be implemented so quickly. A thorough knowledge of the material to be reclaimed is essential. The reclaimer needs to be able to identify the construction and each component. The programme consists of the study of logistics, sorting, identification, separation, chemical, mechanical and textile recycling, combustion, and the reuse of the recyclable materials – in other words, a full closed cycle.

Table 5
GuT test laboratories

BTTG	UK
Centexbel	Belgium
DTI	Denmark
OTI	Austria
TFI	Germany

Table 6
Öko-Tex product-specific standards

Product Class I	Products for baby clothing All articles, basic materials and accessories which are provided for the production of articles for babies and children up to two years old.
Product Class II	**Products with direct skin contact** Articles worn with a large part of their surface in direct contact with the skin, e.g. blouses, shirts, underwear.
Product Class III	**Products not having direct skin contact** Articles worn with only a small part of their surface in direct contact with the skin, e.g. linings, trousers, jackets
Product Class IV	**Decoration material** Articles including products and accessories which are used for decoration, such as tablecloths, furnishing fabrics, curtains and floor coverings.

Table 7
Criteria for Öko-Tex Product Class II – Direct Contact with Skin

pH	4.0-7.5
Formaldehyde	75 ppm
Pesticides	1.0 ppm
Pentachlorophenol	0.5 ppm
Tetrachlorophenol	0.5 ppm
Heavy Metal Residues (Extractable)	
Cr 2.0 ppm	Cr VI ND
Co 4.0 ppm	Ni 4.0 ppm
Cu 50.0 ppm	As 1.0 ppm
Pb 1.0 ppm	Cd 0.1 ppm
Hg 0.02 ppm	
Dyes MAK Groups III A1 and A2	Banned
Carcinogenic	Banned
Allergenic	Banned
Chlorinated Organic Carrier	1.0 ppm
Biocide Finish	Banned
Flame Retardant Finish	Banned
Colour Fastness	
Odour	

The Öko-Tex scheme

Unlike that of GuT, the Öko-Tex scheme is not based on a formal membership structure. It is open to any manufacturer or supplier of textile and leather products. The objectives are similar to those already noted for GuT and the EU Eco-labelling scheme. Application for testing is made to the appropriate test institute, of which there are twelve.

The general conditions for granting authorisation to use the Öko-Tex mark and certificate are specified in Öko-Tex Standard 100. Authorisation is given by the Öko-Tex approved laboratory that carried out the test procedures.

As in the case of the GuT Signet, the Öko-Tex Mark is not a quality label. It relates only to the as-purchased state of the product. However, once again the applicant is encouraged to operate and maintain an effective quality assurance system.

When all the conditions are fulfilled, a certificate which is valid for one year is issued, giving the applicant the right to use the Öko-Tex mark on the product. To ensure that the test conditions are maintained, each test laboratory is authorized to carry out random tests on sales products during a twelve-month period. If random tests reveal deviations from the test base, then the certificate may be withdrawn.

Examples of the test areas for Product Class II, Direct Contact with Skin, are shown in **Table 7**.

The Öko-Tex certificate is applicable only to the textile product. It does not include the site of manufacture. Within the GuT scheme, all the floor covering products are manufactured within Europe; in fact, all the members and associate members are within the EU. Consequently, there is no difficulty in carrying out site monitoring and auditing. On the other hand, the textile products submitted for Öko-Tex testing can be manufactured in any country, which is why a manufacturer *or* supplier of the merchandise can apply for a certificate. There is therefore an opportunity for manufacturers outside Europe to have their products tested through a European supplier or Test House.

Green or bust

Are environmental protection measures a barrier, a threat, or a challenge? The ban on the use of certain dyes, particularly azo dyes and the vast majority of metal-complex dyes, and the tightening of levels of heavy metals residues, are certainly causing processing difficulties, particularly where the process's purpose is to satisfy fastness and colour requirements. Again, limits on organic emissions and the level of certain chemicals in the finished merchandise cause difficulties. However, the tetile industry is left with the challenge of developing more effective processing technologies.

Industry cannot ignore the environmental impacts of its activities. Consumer awareness of environmental issues in Europe is increasing. Grasping the opportunities this presents and taking an enlightened approach to environmental protection can bring about considerable benefits:

- greater efficiency, because all operations must be studied and analysed;
- enhanced company status in the eyes of customers and financial institutions;
- improved company performance, because of increased awareness of environmental responsibility throughout the whole of the staff.

Eco-labelling protocols are certainly awakening the minds of many in the textile chain to these questions, and they are here to stay.

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The outlook for the China Green Lights Programme

Zhou Dadi, Vice President, Institute of Energy Research of the State Planning Commission, and
Liu Hong, Engineer, Beijing Energy Efficiency Centre, Zhansimen Shahe, Changping County, Beijing 102206, People's Republic of China

Abstract

The Green Lights Programme has been implemented in both developed and developing countries since 1992. The China Green Lights Programme (CGLP)is the main energy conservation project of the Ninth Five-Year Plan. The CGLP will play an important part in saving resources, protecting the environment, raising China's standard of living, and improving the quality of manufactured lighting equipment (a large percentage of which is exported).

Résumé

Green Lights est un programme mis en œuvre depuis 1992 dans les pays développés et dans ceux en développement. Le programme Green Lights de la Chine est le plus gros projet d'économies d'énergie du neuvième plan quinquennal chinois. Il devrait apporter une contribution majeure à la réalisation des objectifs concernant les économies des ressources, la protection de l'environnement, l'amélioration du niveau de vie et la qualité des équipements d'éclairage (en grande majorité exportés).

Resumen

El Programa Luces Verdes se puso en práctica tanto en los países desarrollados como en aquellos en vías de desarrollo a partir de 1992. El Programa Chino de Luces Verdes (CGLP) es el principal proyecto de conservación de energía del Noveno plan quinquenal. Tendrá un papel importante en la economía de los recursos, la protección del medio ambiente, la mejora del nivel de vida y el aumento de la calidad de los productos manufacturados de alumbrado (de los cuales se exporta un gran porcentaje).

The goals and significance of the China Green Lights Programme (CGLP)

China has immense energy-producing resources. Although it ranks third worldwide in the production of electric power, its electricity supply remains insufficient to satisfy the requirements of economic development. Moreover, in China fossil fuel power plants are prevalent and will continue to be so for a long time to come. The government has therefore paid great attention to the China Green Lights Programme (CGLP). Since 1992 the Green Lights Programme, an effective initiative designed to save energy and protect the environment, has been implemented in many developed as well as developing countries.

Electricity used for lighting accounts for approximately 10 per cent of China's total electricity consumption. While this percentage is lower than in some developed countries, electricity use for lighting has recently increased considerably, with an annual growth rate of over 15 per cent. In 1995 total electric power production was 1000 TWh, while consumption for lighting was approximately 100 TWh, exceeding for example the projected annual production of the Three Gorge hydroelectric power station (84 TWh) which is presently under construction.

It has been estimated that electricity use for lighting will exceed 150 TWh by the year 2000. However, if we can learn from the successful experiences of other countries in implementing the Green Lights Programme, modify the activities they have undertaken to suit our own national conditions, and so carry out the CGLP in China, by 2000 electricity demand for lighting could be reduced by 20 per cent, i.e. 30 TWh annually.

Not only is the implementation of the CGLP in China consistent with energy policy ("Importance should be attached to both conservation and exploration, [but] priority should be given to the former"). It is also consistent with the change in China's economic development from "extensive" to "intensive". In April 1994 the State Economic and Trade Commission (SETC) of the People's Republic formally listed the China Green Lights Programme (CGLP) in China's Ninth Five-Year Plan as the major energy conservation project. It established an Executive Panel, Project Office and Expert Panel and decided that the CGLP would be implemented through the collaboration of the SETC, China National Council of Light Industry, Ministry of Electronic Industry, Ministry of Agriculture, etc.

During the period of the Ninth Five-Year Plan, the main goals for the implementation of this programme are as follows:

1. to expand the manufacture of efficient lighting equipment and form a new industry, with good economic benefits, geared to improving lighting quality and promoting energy conservation and environmental protection;

2. to develop and improve the present management system for efficient lighting equipment, to bring the effects of government macroregulation, macrocontrol and market regulation into full play, and to introduce energy conservation to the lighting equipment market;

3. to improve lighting quality, and to develop an efficient and comfortable lighting system which is at the same time beneficial to the environment;

4. to save electricity, and to actively promote and popularize the use of efficient lighting equipment nationwide. The annual electricity saving could reach 30 TWh by the year 2000 (see above) if 300 million compact fluorescent, thin-tube fluorescent, and other efficient types of lighting were used.

The necessity and background of CGLP implementation

Implementation of the CGLP is necessary

Lighting equipment, which is second only to electric motors in total electricity consumption, is dominated by low-efficiency equipment. Conservation of electricity used for lighting has great potential. It is the main object of end-user conservation efforts. Consumption for lighting primarily contributes to peak load demand. Increased efficiency can reduce generating capacity requirements, helping to narrow the large electricity supply/demand gap. At present China's electricity supply is based on the use of coal-fired power plants, which are the country's greatest source of SO and CO emissions. It is urgent for us to take steps towards eliminating the generation of these and other pollutants.

China lags behind developed countries in the technical development of lighting equipment manufacture. Relevant standards, laws and policies are lacking; the lighting equipment mix is unsuitable; the production of raw materials and parts is not well coordinated; the general scale of manufacturing is small; the level of automation is low; manufacturing technology is out-of-date; and the quality of equipment is not consistent. In addition, the lighting equipment market is disorganized. Imitation and inferior quality equipment has a severe impact, damaging the reputation of better quality equipment. All of these problems need to be solved step-by-step, through the prompt implementation of the CGLP.

Background of implementation

On the occasion of the Party's First Plenary Session of the Fourteenth Central Committee and the Eighth Session of the People's Congress, the distribution of resources on the basis of efficiency and economic considerations was proposed. The transformation of China's economic growth style and the realization of the importance of sustainable economic and social development have created favourable macroconditions for the formulation and implementation of the CGLP.

Since the open policy began, great progress has been made in lighting equipment quality and production capacity. Advanced technologies and equipment have been imported, and an initial scale has been established for measuring production efficiency. At present, more than 1000 enterprises produce lighting equipment. In 1994 the annual output of lighting sources totalled 4 billion, including 2.4 billion incandescent, 300 million fluorescent, 80 million compact fluorescent, and 160 million other. Compact fluorescent production made up more than one-third of total world production, and 80 per cent was exported. The quality of the high-pressure sodium and metal halide light sources basically come up to advanced world standards.

Lighting sources within China have mainly been low-efficiency incandescent, followed by thick-tube fluorescent. Efficient lighting is still rarely used, and its rate of popularization is slow. However, the demand for improved housing conditions and living environments (and hence efficient lighting) will grow with economic development.

The main content of the CGLP

1. Plans for education and information dissemination, to increase public awareness of the importance of reducing electricity consumption and of the economic and environmental significance of the Green Lights Programme.

The main goals of these plans include regular dissemination of information on the CGLP to the public through the mass media in order to increase awareness of the importance of electricity conservation and environmental protection and encourage citizens to participate in the CGLP; spreading knowledge and introducing the conservation of electricity used for lighting by organizing various public welfare activities such as lectures, workshops and training courses; and establishing demonstration centres for CGLP, to be used as long-term public showcases, in major cities.

2. Policy development and macroregulation, to formulate relevant measures and enhance policy guidance.

While allowing the full play of the fundamental effects of market regulation on the distribution of resources, the governmental functions of supervision, service and coordination should be enhanced. This will include creating necessary supplements to laws and regulations concerning electricity conservation, which may also require modification and adjustment; researching and formulating incentive policies for conserving electricity used for lighting; establishing a national green lighting information system; and providing information services for policymakers, researchers, designers, manufacturers and consumers.

3. A certification and labelling plan, to increase equipment quality, establish brand image, and develop a quality certification and labelling system for green lights equipment.

Major activities will be research and design certification and labelling for green lights equipment; organization of testing and monitoring organisms to undertake certification and labelling activities; and regular investigation and appraisal of equipment certification procedures in order to be able to assure consumers that the equipment they purchase will meet their expectations.

4. A pilot and demonstration plan, to seek efficient channels and accumulate successful experience.

Pilot and demonstration projects will be developed, taking into consideration local characteristics and specific conditions, in order to benefit both society and individual groups. The demonstration projects will include an urban public lighting system; replacement and retrofit of the lighting system of a large hotel and commercial buildings; and efficient lighting system design for new buildings.

5. Finance plans, to raise the level and increase the scale of production of high-quality equipment.

Based on equipment certification and enterprise investigation, SETC will invest in some certified enterprises through CGLP financing for technology development and expansion of production capacity.

6. International collaboration plans, to expand international exchanges and influence and import advanced technology and experience.

To make use of both international and domestic resources and markets, and to attract foreign manufacturers of lighting equipment to take part in the implementation of the CGLP; and, at the same time, to increase financial support from international financial institutions for CGLP implementation through benefiting from concerns for global environmental protection and from the activities of the Green Lights Programme, and to make use of such successful experience as is applicable to China.

Characteristics of the CGLP

Implementation of the CGLP will proceed in accordance with the situation in China. A uniquely Chinese Green Lights Programme will be created, complying with the principles of coordinated growth of energy, the economy, and environmental protection and making use of other countries' experience with the Green Lights Programme.

Adoption of the market mechanism

After more than ten years of the open policy, China is gradually moving towards a mature socialist market economy system. The mechanism of market competition will be incorporated in CGLP implementation. The selection and popularization of green lighting equipment should follow the rules of certification and labelling, corresponding to the principle of "survival of the fittest". The state will support equipment with good technical and economic characteristics, so that its market share can be increased.

Demand side participation

The CGLP implementation procedure differs from that of other energy-saving programmes. The CGLP does not start with the enterprises taking part in production (the supply side) and simply invest in them. It involves lighting equipment-producing enterprises, utilities and end-users. The active participation of users (the demand side) will play an important role in the success of the CGLP. Therefore, the CGLP will launch a large number of educational/science popularization activities to increase public awareness of the need for electricity conservation and environmental protection. At the same time, participating users will benefit from a preferential policy.

Government pilot and macrocontrol policies

Because the change from a centrally planned to a market economy is still in its initial stages, government pilot and macrocontrol policies should be very important for a country-wide, socially systematic project like the CGLP. Government administrative agencies should adopt properly the methods of a market economy, in order to carry out the functions of supervision, service and coordination, and should formulate a series of policies, laws and standards to encourage and promote the CGLP in accordance with relevant laws concerning energy conservation and environmental protection.

Renewal of the lighting equipment industry, taking into account electricity conservation and environmental protection needs

At present most lighting equipment-producing enterprises are operating with outdated equipment and technology. Modernizing them is imperative. The popularization of the CGLP will point the direction for the renewal of this industry and contribute to the development of China's society and economy.

International collaboration

China is a rapidly developing country. It receives much attention from a number of international organizations in regard to its energy and environmental problems. To benefit from the global scope of the Green Lights Programme, and to obtain financial support, the CGLP will actively solicit advanced technology as well as capital and apply to relevant organizations such as the World Bank, the Asian Development Bank and UNDP for financial aid including low-interest loans. The CGLP also welcomes the participation of foreign manufacturers in the lighting equipment market, where cooperation would be mutually beneficial.

The status of CGLP implementation

As early as 1993 relevant institutes and experts, organized and led by the SETC, carried out a series of research, investigation and demonstration activities related to implementation of the CGLP. Many CGLP pilot projects were carried out, in several cities. In Shandong Province, for example, the Shandong Economic Commission, Shandong Electricity Bureau and Shandong Office of Triple Electricity produced documents based on previous tentative experiences. The main purposes of these documents were: (1) to designate and popularize high-quality lighting equipment; (2) to control the prices of energy-saving lighting equipment and sell it at a discount; and (3) to guarantee after-sales service. Between September 1995 and February 1996, Weifang City in Shandong Province put into use nearly 2 million energy-saving lighting units, resulting in an annual saving of 80,000 Kw of electricity. This was a remarkable achievement.

The Office and Expert Team of the CGLP have begun preparation and organization for CGLP implementation. Teams for policy research, standards setting, demonstration system design, and demonstration projects have already begun work. CGLP activities during Energy Conservation Week in October 1996 included publicizing the CGLP through the mass media, an International Symposium on Green Lights in China, and the opening of the Beijing Demonstration Centre for the China Green Lights Programme.

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Market transformation strategies for high-efficiency appliances

Denise Rouleau, Consortium for Energy Efficiency (CEE), One State Street, Suite 1400, Boston, Massachusetts 02109, USA, **Loretta A. Smith**, formerly with the American Council for an Energy-Efficient Economy (ACEEE), 10001 Connecticut Avenue, NW #801, Washington, D.C., USA, and **Marika Tatsutani**, formerly with the Consortium for Energy Efficiency (CEE)

Abstract

Utility companies in the United States and Canada have made significant investments in recent years in programmes that motivate consumers to purchase more efficient appliances and other equipment. However, there has been a good deal of variation in these demand-side management programmes. As companies look for more cost-effective ways to undertake such programmes, and thus to promote energy efficiency as a public good, attention is increasingly focused on approaches which seek to achieve widespread, long-term transformation of markets.

Résumé

Les entreprises d'électricité américaines et canadiennes ont ces dernières années investi des sommes considérables dans des programmes incitant les consommateurs à acheter des appareils et autres équipements à meilleur rendement énergétique. Ces programmes d'action sur la demande sont très différents les uns des autres. Recherchant des moyens plus rentables de mettre en œuvre ces programmes et de promouvoir le rendement énergétique en tant que bien collectif, les entreprises se tournent de plus en plus vers les approches qui visent une transformation à long terme et à grande échelle des marchés.

Resumen

Las compañías eléctricas en los Estados Unidos y Canadá han efectuado inversiones considerables en los últimos años en programas que incitan a los consumidores a adquirir electrodomésticos y otros artículos más eficaces. No obstante, han habido muchas diferencias en los programas de gestión de la demanda. Mientras que las compañías buscan modos más rentables de emprender tales programas y por consiguiente fomentar la eficacia de energía como bien público, se centra cada vez más la atención en enfoques que traten de lograr una amplia transformación a largo plazo de los mercados.

This is a revised version of an article with the same title published in the 1995 International Appliance Technical Conference Proceedings. Denise Rouleau can be contacted on tel. +1 (617) 589-3949, extension 204; E-mail: drouleau@CEEforMT.org.

Introduction

Under the rubric of integrated resource planning, utilities in the United States and Canada have made considerable investments, over recent years, in demand-side management (DSM) programmes. Frequently, these programmes have involved financial or other incentives, as well as educational and promotional efforts, to motivate customers to choose energy-efficiency equipment or appliances. For example, the average residential central air conditioner purchased in the US in 1993 had a seasonal energy efficiency ratio (SEER) of 10.6 (ARI 1994) while over 200 utility air conditioner rebate programmes operating in the 1990s targeted units with SEERs of 11 or higher (Blevins and Miller 1992).

However, past utility DSM programmes have often failed to achieve widespread, sustained changes in the national product market. An important limitation has been the fact that programmes vary widely from utility to utility, with no single programme providing a clear market signal at a national, or even regional, level. Because programme requirements differ, manufacturers and consumers have lacked clear targets as to what constitutes super-efficient products. At the same time, no single utility has represented a large enough market to motivate manufacturers to invest in the development and commercialization of super-efficient products. As a result, even after spending millions of dollars on rebates, utilities have often not seen a long-term increase in the availability of efficient products – or a lasting reduction in the price of efficient products – after their programmes end.

The CEE approach

To address these issues, a group of utilities and other organizations formed the Consortium for Energy Efficiency (CEE). This non-profit organization has members from the utility industry, government agencies, research institutions, and public interest groups. The goal of CEE is to develop and expand markets for super-efficient technologies, using market transformation strategies. These Golden Carrot® initiatives address many of the limitations of traditional administered DSM programmes discussed above. They also often reduce the burden and cost of programme administration on participating utilities themselves, an important concern in the current era of tightening utility budges (Nadel 1995).

The Super-Efficient Refrigerator Programme

CEE grew out of the Super-Efficient Refrigerator Programme (SERP, Inc). SERP, Inc. is a non-profit origination with over 20 electric utility members. Their goal is to significantly advance the technology of refrigerators/freezers (R/F's) and to bring highly efficient and environmentally friendly R/F's to the marketplace at only a slight cost premium and well in advance of "business as usual" market expectations.

In order to achieve this goal, SERP members pooled over $30 million in 1992. They offered this money as a "golden carrot" in a contest for refrigerator manufacturers willing to develop a full-featured refrigerator that was at least 25 per cent more efficient than 1993 US standards require and did not use CFC's in the refrigerant and insulation. To receive the award, the winning manufacturer was also required to distribute at least 250,000 units between 1994 and 1997 (SERP 1993).

This contest resulted in an award to a major refrigerator manufacturer in June of 1993. The SERP member utilities serve over 20 million of the 94 million households in the US (Wald 1992), thus accounting for a substantial portion of the residential market. SERP refrigerators are now available to consumers at retail outlets in the service territories of participating utilities. Beyond those directly served by SERP member utilities, press coverage of SERP efforts reached nationwide and in fact SERP units are being marketed in areas outside of member utility service territories (L'Ecuyer 1994). The multi-year duration of the programme also addressed manufacturer concerns about continuity and consistency of such programmes.

SERP represents a first, and highly successful, application of the Golden Carrot® approach that CEE is now seeking to apply to other products and technologies. By pooling resources, SERP utilities affected refrigerator technology in a way that would not have been affordable for any single utility. Through SERP, utilities were able to demonstrate that significant improvements in refrigerator technology were possible and to deliver a clear message to manufactures and consumers about the benefits and desirability of greatly enhanced energy efficiency.

Current CEE efforts

Drawing upon the SERP experience, CEE began its first programmes in 1993 and set up exploratory subcommittees to develop market transformation strategies for a variety of residential, commercial, and industrial appliances and equipment. Six CEE initiatives have been launched to date for:

- residential clothes washers;
- residential air-source air conditioners and heat pumps;
- commercial air- and water-source packaged air conditioning and heat pump equipment;
- compact fluorescent lamps;
- apartment sized refrigerators; and
- premium efficiency motors.

In addition, there are currently subcommittees analysing potential initiatives for residential heat pump water heaters, vending machines and beverage coolers, gas technologies, chiller systems, and super-efficient household appliances. The existing residential clothes washer and residential air conditioner and heat pump programmes are detailed below as examples of the CEE approach.

The CEE Residential Clothes Washer Initiative

The first initiative to be officially launched by CEE was the High-Efficiency Residential Clothes Washer Initiative. The initiative is aimed at helping utilities to promote clothes washers that consume significantly less energy and water than most models commercially available in the US.

The initiative sets minimum thresholds for participating utility incentives (**Table 1**) based upon washer performance, as measured by energy factor (cubic foot of washer capacity/kWh consumed/wash cycle), water factor (gallons of water consumed/wash cycle/cubic foot of washer capacity), and remaining moisture content (weight of remaining water in cloths after the spin cycle, as a percentage of dry weight of clothes).

Clothes washers that meet the CEE specifications will consume less than half the energy and one-third less water than washers that meet current federal minimum efficiency standards. In typical households with electric resistance water heating, energy savings of 318 kWh and water savings of 4900 gallons annually could be expected with a washer that meets CEE specifications as compared to a washer meeting current federal standards (CEE 1993).

The CEE criteria are currently only met by horizontal axis (H-axis) washers. Clothes washers that use a horizontal axis design are generally more efficient (in terms of both energy and water consumption). Although over 90 per cent of European clothes washers have a horizontal axis design, they have accounted for only 2-3 per cent of the residential clothes washer market in the US (Pope and Slavin 1992). A number of US manufacturers have introduced H-axis models as of mid-1997. With expected replacement of approximately 5 million residential washing machine units in the US annually throughout the 1990s (Appliance 1993), this could result in significant energy and water savings nationwide. As more and more horizontal axis and other high-efficiency models become commercially available, CEE anticipates that an increasing number of utilities will help to stimulate market demand for these units through their participation in this initiative.

Table 1
CEE High-Efficiency Clothes Washer Initiative Criteria

Programme level	Energy factor (cu. ft./kWh/cycle)	Water factor (gal./cu. ft.)	Remaining moisture content (%)
Baseline Reference*	1.18	14.4**	70 **
Tier 1A	2.5	11	no requirement
Tier 1B	2.5	11	50
Tier 1C	2.5	11	40
Tier 2A	3.25	9.5	no requirement
Tier 2B	3.25	9.5	50
Tier 2C	3.25	9.5	40

* Vertical-axis unit meeting DOE 1994 standards.
** Average value for baseline reference units; these metrics are not required in the DOE standard.

The CEE Residential Air-Source Air Conditioning and Heat Pump Initiative

Air conditioning accounts for approximately 16 per cent of residential energy consumption in the US (EIA 1993). Furthermore, improving air conditioning energy efficiency is of particular interest to electric utilities since its use generally coincides with periods of peak electric grid demand. As of 1992, over 200 utilities were offering incentives for high-efficiency air conditioners for their residential customers (Blevins and Miller 1992). However, these incentive programmes were extremely diverse, targeting varied efficiency levels for either, or both, seasonal and peak performance metrics. Additionally, very few programmes targeted installation practices, a critical component in insuring efficient system performance.

The CEE initiative for residential systems covers single-phase single-package and split system air conditioners and heat pumps up to 65,000 Btu/hours (5 ton) cooling capacity (CEE's commercial air-conditioning initiative covers three-phase equipment and equipment over 65,000 Btu cooling capacity) (CEE 1994). The programme has two components: an equipment efficiency component and an installation component. The equipment efficiency component consists of multiple efficiency tiers: two initial tiers based on equipment being sold today; and a series of higher tiers based on additional efficiency improvements, for which higher incentives are recommended. For the highest tier, little equipment is on the market today. The equipment efficiency tiers are shown below in **Table 2**.

The number of available energy-efficient central air conditioner models has increased markedly between 1994 – when the programme began – and 1997, in large part because of utility sponsorship nationwide for CEE's common efficiency tiers. Over fifty percent of current models now meet at least the minimum CEE levels, with growth in the number of super energy-efficient models offered as well.

The installation component consists of a set of installation guidelines that utilities can require their customers to follow to be eligible for incentives. CEE recommends that utilities incorporate the installation guidelines in their programmes to maximize actual energy savings, but adoption of this component is not required for utility participation in the initiative.

Other activities

In addition to the CEE subcommittees currently exploring market transformation strategies for other technologies (see above), CEE is working with the Energy Efficiency Procurement Collaborative to facilitate the availability of databases of high-efficiency products that can be used by utilities and government procurement agencies.

Table 2
Residential Initiative Efficiency Tiers

Tier*	Cooling performance SEER	EER	Heating performance HSPF
1	12	10.5	7.0
2	13	11	8.0
3	14	12	8.5
Advance	15 & above	12.5 & above	9.0 & above

*Tier 0 (SEER 11, EER 9.9, and HSPF 7.0) was in place through 1995 and was eliminated since over 40% of available equipment already met the Tier 0 efficiency level.

The larger picture

We have discussed here only a few of the initiatives CEE has launched or is actively exploring. These activities are being undertaken at a time of significant change and under increasing budget constraints, not only at utilities but in state and federal government agencies as well. There is also a basic recognition that utilities acting independently cannot effectively achieve market transformation, particularly those involving national markets. While many states continue to require least-cost planning to acquire the traditional DSM resource of energy efficiency, a number of statewide and regional approaches to market transformation have recently been launched. Furthermore, due to utility restructuring there is growing recognition by stakeholders that promotion of market transformation is a way to promote public benefit energy efficiency. In this context, CEE's market transformation approach may be increasingly attractive to utilities and others who are seeking to achieve highly cost-effective energy savings that are sustained over the long-term by a healthy, competitive market for efficient products.

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AGROENVIRON, 98
International Symposium

Agro-environmental issues and future strategies: towards the 21st century

May 25-30, 1998

Intensive agriculture, deforestation, waterlogging, salinity, industrialization and population explosion have introduced changes that are threatening life on the globe. For abatement purpose, awareness campaigns, extension programmes, and legislation and research studies are being planned/executed. Both public and private agencies are working. However, there appears a gap between the word and the action since the programmes lack understanding. There is a need that the community should discuss agro-environmental problems and suggest strategies for a better future. In view of this, the following topics related to agro-environmental issues are proposed for paper presentation at the symposium.

A. Agro-chemicals and groundwater contamination,
B. Agricultural machinery related noise pollution, soil compaction, erosion etc,
C. Agro-industrial pollution and control,
D. Acid rains and air pollution,
E. Agro-environmental impact assessment and legislation,
F. Industrial/sewage irrigation and soil pollution,
G. Modeling agro-environmental systems,
H. Farm wastes, recycling and energy generation,
I. Mountain deforestation and management,
J. Any other.

Paper abstract due on: November 15, 1997

Contact for further information:
Prof. Dr Jehangir Khan Sial
Symposium Director
Faculty of Agricultural Engineering & Technology
University of Agriculture, Faisalabad, Pakistan
Tel: +(92.41)30281-89/Ext. 434
Fax: +(92.41)33214/647846/30679
E-mail: iqrar@ptccuaf.fsd.brain.net.pk
(Att: J.K. Sial)

Eco-design: benefit for the environment *and* profit for the company

Harriët Böttcher, EcoDesign project coordinator, and René Hartman, EcoDesign project leader, InnovationCentre Amsterdam/Haarlem, Postbus 19408, 1000 GK Amsterdam, the Netherlands

Abstract
Through the EcoDesign project, over the last two years hundreds of small and medium-sized enterprises in the Netherlands have been introduced to the principles of Environmental Product Development. The project is coordinated and implemented by the non-profit InnovationCentres. Solutions are sought which will provide both environmental benefits and commercial gains for the participating companies.

Résumé
Depuis deux ans, grâce au projet EcoDesign des centaines de PME néerlandaises découvrent les principes du développement de produits respectueux de l'environnement (Environmental Product Development). Des associations à but non lucratif, les "Innovations Centres", assurent la coordination et la mise en oeuvre du projet. Le but est de trouver des solutions qui apportent à la fois des bénéfices en termes d'environnement et des gains commerciaux aux sociétés participantes.

Resumen
En estos últimos dos años, mediante el proyecto de diseño ecológico, cientos de pequeñas y medianas empresas en Holanda se han iniciado en los principios de Desarrollo de Productos Medioambientales. Los Centros de innovación sin fines de lucro coordinan y desarrollan este proyecto. Se apunta a soluciones que permitan a su vez beneficios medioambientales y comerciales para las empresas que participan en el mismo.

Small and medium-sized enterprises (SMEs) play a greater role in Dutch industry than is commonly supposed. For instance, SMEs account for almost 90 per cent of the product innovations launched each year.

A number of these SMEs are extremely innovative in the environmental field. They can be counted among the "green avant-garde". But this leading group is not representative of the entire sector. In contrast to large companies, this category of companies seldom have their own Research and Development departments. Furthermore, their knowledge of environmental agreements and other regulations in the environmental field is limited. Many SMEs have neither the time, the money nor the staff to focus on the environmental aspects of their own products and processes or on environmental regulations, including those planned for the future. The environment often plays only a small role in the innovation process in SMEs, despite the fact that there are major benefits to be gained in that area both for the environment and for the companies themselves.

Against this background, the Dutch Ministries of the Environment and Economic Affairs decided in 1994 to finance the EcoDesign project. The general aim of EcoDesign is to raise awareness among SMEs of the importance and potential of Environmental Product Development. Environmental protection measures must no longer be seen as a threat but as an opportunity to cut costs, improve market position, and produce a product which is, in a number of respects, better. To achieve this goal, companies are advised on environmental innovation for one of their products and in this way taught to appreciate the value of Environmental Product Development. When they then go on to integrate this innovation into their regular product development process, a major goal of the EcoDesign project has been achieved.

Table 1
Distribution of participating companies by major branches (as percentage of total participants)

Branches	1995	1996
Rubber and plastic	12	6
Wood and furniture	13	11
Metal products	18	11
Machines/appliances	15	13
Wholesale trade	6	11
Total of five largest branches	64	52

Table 2
Options found by 1995 and 1996 EcoDesign participants, according to strategies

Strategy	1995	1996
0. Improved functionality	4	8
1. Better materials	18	20
2. Less materials	16	9
3. Better production techniques	13	14
4. Improved distribution	7	9
5. More efficient use	11	11
6. Optimization of life cycle	11	13
7. Improvement in waste phase	21	15

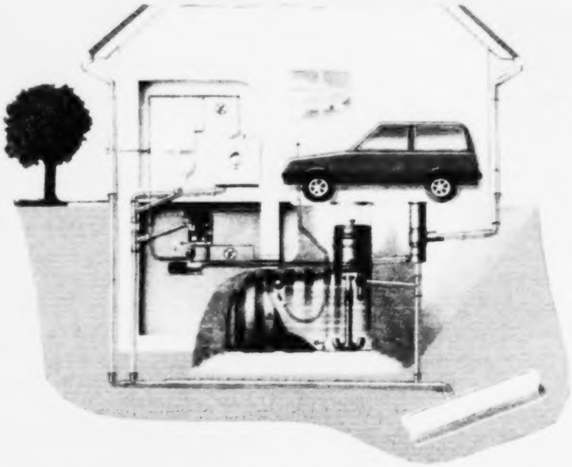
The EcoDesign Project is coordinated and implemented by the InnovationCentres, a non-profit organization set up in 1988 by the ministry of Economic Affairs to fill a gap in the Dutch "knowledge infrastructure". The InnovationCentres are an organization with a low threshold in which people with a broad range of technological knowledge are available to advise small and medium-sized companies and institutions, put them in touch with the right specialists, and create partnerships. The Netherlands now has 18 independent regional InnovationCentres which together form a "network", the ICNN. They employ a total of around 140 advisors who provide advice to some 20,000 small and medium-sized enterprises each year.

The InnovationCentres are not commercial consultancy firms. The advisors can work for a company free of charge for up to 16 hours a year. They restrict themselves to the initial phases of the innovation process: the analysis of problems and the search for options for a solution. The company ultimately has to decide for itself whether it wants to invest, join forces with suppliers, hire consultancy firms, etc. The InnovationCentres are first and foremost a catalyst.

The EcoDesign approach

The target group consists of an estimated 4500 companies in the small and medium-sized business sector which, to a large extent, determine the specifications of their own products. The specific objective is to enable 900 companies in the target group to gain practical experience with Environmental Product Development during the period 1995-1998. For this purpose, over 20 advisors from the InnovationCentres have been trained in the EcoDesign method. Three-quarters of them already had a great deal of experience with product development, and 25 per cent had worked on "Cleaner Production" projects and are therefore very much at home with process technology. Twelve project assistants were hired to support the IC advisors. Most of the assistants had become

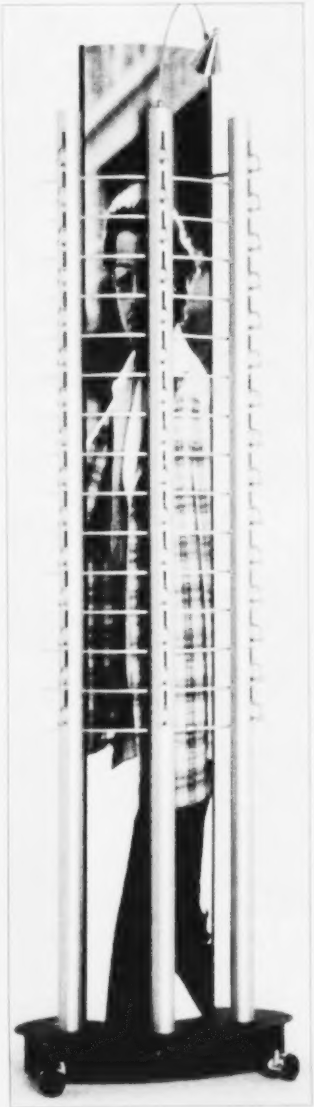
Example 1: Innovation in function

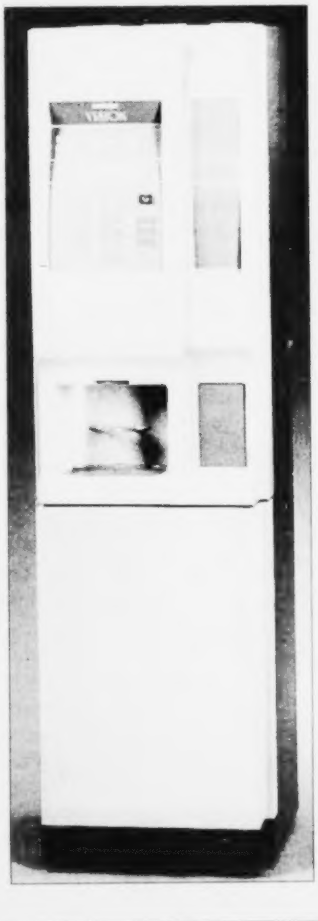


Montage Service Braak B.V. in Sittard is a welding and assembly company. It thought up a highly innovative product which makes it possible to use rainwater for household use, the Heflex water system. This system consists of an underground tank from which a pump sends water to various taps. Rainwater is conducted to the storage tank via drainage pipes and a treatment filter. With this system it is possible to use rainwater for purposes for which pure drinking water was used up to now, such as flushing toilets and watering the lawn. The consumption of drinking water can be reduced by 30 per cent in households and by as much as 50 per cent in larger buildings. The costs of installing the system for small-scale use can be recovered in eight years. For large users the payback period is three to five years. The product, which was developed in association with the Innovation Centre South Limburg, has attracted a lot of interest, especially in Germany (where drinking water is far more expensive than in the Netherlands).

Example 2: Decrease in the use of energy and consumables

Mobile Containing B.V. in Dordrecht produces plate stackers for company canteens, motorway restaurants and care centres. The machine keeps plates warm so that the food served does not cool down too quickly. A new modified plate stacker was designed with the advice of the Innovation Centre South Holland South. The former design consisted of just one unit, which was heated entirely. The new design only heats the two cylinders in which the plates are stacked. If only one cylinder is being used, the other can be switched off. The cylinders are significantly better insulated. The energy consumption of the new plate stacker is 30-40 per cent lower, allowing the additional cost in relation to the old product to be recovered within some years. The company anticipates an increase in turnover.





Example 3: Improvements in the waste disposal phase

Veromatic International B.V. in Dordrecht produces machines for hot drinks, from small models (coffee, hot chocolate and hot water) to very elaborate systems that can also serve, for example, soup and soft drinks. The machines are exported to countries whose environmental legislation is stricter than that of Netherlands. Veromatic has committed itself to taking back discarded machines from 1 January 1999. In anticipation of the return of the machines, Veromatic has started redesigning them. The new systems mainly consist of two synthetic materials that are very suitable for recycling. Assembly and disassembly have been facilitated. The redesign of the machine has reduced its energy consumption.

familiar with environmental product development during their studies (at the Delft University of Technology, for instance).

An important element of the EcoDesign project is to provide information to companies. To this end, meetings are organized at which companies can learn the principles of environmental product development and the approach of the EcoDesign project. The advisors of the InnovationCentres also raise these topics at introductory interviews with the entrepreneurs, thereby giving the company a clear impression of the EcoDesign approach. This personal approach appears to have a particularly strong impact in giving many people the sense of participation.

Environmental Innovation Scan

When a company decides to take part in the project, one product suitable for the EcoDesign approach is chosen in consultation with the IC advisor. The IC advisor employs a special research method to study the product: the Environmental Innovation Scan.

This scan is designed to give the company a well reasoned and clear insight into the possibilities for improving the product, and not only environmental improvements. The study covers every aspect that is relevant to the future success of the product and of the company. For instance, the legal implications of legislation, agreements, export regulations and subsidies are itemized. The company's market position is studied: How does the company compare with its competitors? In what areas does it have a lead, and where is it lagging behind? What demands will the environmental movement and consumer groups, for instance, place on the product?

For the purposes of the scan the IC advisors use background information from various databanks. The InnovationCentres Network has compiled an *ExpertiseMap* ("Expertise File") which includes information on product policy in the Netherlands and elsewhere, a description of databases and other sources of information, and data about external design, research and consultancy firms, including a summary of environmental studies they have carried out. For the team of advisors there is also a database containing all EcoDesign case studies. It is therefore easy to quickly find the most likely potential improvements by type of product. The advisors also consult each other directly via the internal computer network. For specific questions about materials, international legislation, eco-indicators and similar themes, they have access to an *Achterwach* ("Backup team") comprising staff members of the Industrial Design faculty at the Delft University of Technology.

Selecting priorities

Using the information from the Environmental Innovation Scan, the company can then establish priorities: in what direction (or directions) should the innovation proceed? To help them make this choice, EcoDesign uses a tool known as the EPD Strategy Wheel.

The eight "spokes" of the EPD Strategy Wheel represent the various strategies which can be followed to reduce the environmental problems of the product. Reading clockwise, the figure systematically follows the entire life cycle of a product (**Figure 1**).

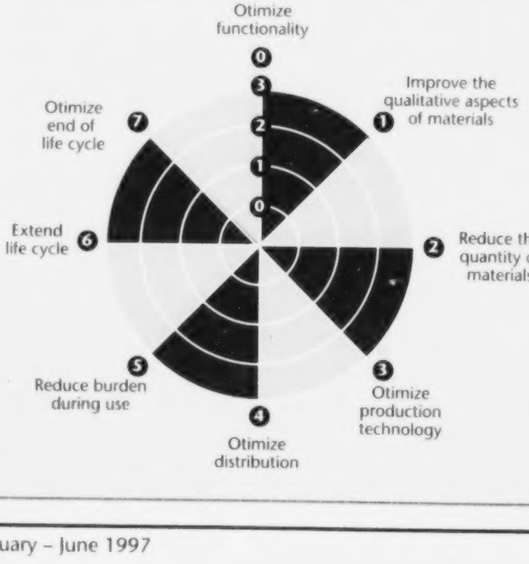
The priority of the various options for improvement are shown on the wheel. This makes it clear at a glance what the company should be seeking to achieve in the innovation process. Incidentally, environmental factors are not the only ones that count in this assessment. Just as much attention is given to "conventional" commercial considerations: competitiveness, production costs, quality of the product, and image. After all, the aim is to create a "win-win" situation, in which both the environment and the company will benefit.

Experience with the EcoDesign projects has shown that carrying out an Environmental Innovation Scan, followed by a strategic discussion based on the wheel, provides the company with a wealth of information as well as giving it a new perspective on its product and market position.

The product development process

Once the strategic choices have been made, the company can start with the environmental development of the product. In some cases, it might be useful to take an intermediate step in the form of a feasibility study. This could be, for example, for the purpose of choosing the best material, establishing the conditions under which the producer could accept returns of his product, the technical feasibility, etc. The study is carried out not by advisors from the InnovationCentres, but by specialist design and consultancy firms. The IC advisor can, however, mediate in hiring the firm and supervise the research. The EcoDesign project finances half of the costs of the feasibility study.

Figure 1
Environmental product development strategy wheel


Otimize functionality
0
3
2
1
0
Improve the qualitative aspects of materials
1
Otimize end of life cycle
7
Extend life cycle
6
Reduce the quantity of materials
2
Reduce burden during use
5
Otimize production technology
3
4
Otimize distribution

There is sometimes no point in a company completing the Environmental Innovation Scan or a full feasibility study, for example if the best improvement option is clearly obvious. In such cases the company can bring in a specialist for one day, at the Innovation Centre's expense, who can help solve the company's specific problems.

The ultimate result of the innovation process should be the marketing of a new product. In general, there is a period of 18 months between the initial idea for a new product and its launch. During this time companies not only have to work on the product itself, but a production plan and a marketing plan also have to be prepared. If new questions arise during the process, the advisor from the Innovation Centre can help resolve them. The advisor can also help the company establish a structure for product development by drawing up a step-by-step plan setting out what the company can do itself and what it should subcontract.

Moreover, the advisor will certainly not omit to draw the company's attention to the possibilities of the Dutch Credit Scheme for Environmental Product Development. Since 1996, SMEs (up to 250 employees) have been able to apply for a development loan to cover the extra costs involved in environmental product development. Financing is in the form of risk-bearing loans: if the product fails in the market, the loan doesn't have to be repaid. The company must demonstrate that the new product "causes demonstrably less harm to the environment", with the lower limit generally being a 20 per cent improvement according to the eco-indicators method. The loan is a maximum of 40 per cent of the total project costs, with a minimum of NLG 10,000 and a maximum of NLG 500,000.

The results of EcoDesign in 1995/96

In 1995 and 1996, almost 250 Environmental Innovation Scans were conducted in the Netherlands, meeting the prescribed target. A comprehensive survey of the companies that took part in the EcoDesign project in 1995 (by Drs. Caroline Van Hemel of Delft University, Faculty of Industrial Design) showed that a large majority of the participating companies were positive about the project and recommended that other companies take part. Two-thirds of the participating companies had proceeded, as a result of the project, to make concrete changes in products or in the way they organized product innovation. According to the study, at least 35 products which have been improved from an environmental perspective through the EcoDesign project have already been introduced or soon will be.

The companies that participated in EcoDesign in 1995/96 form a cross-section of all the small and medium-sized enterprises in the Netherlands. A vast majority (over 80 per cent) have fewer than 100 employees. The majority sell their products predominantly in the Netherlands (37 per cent) or in both the Netherlands and other European countries (50 per cent). Some 13 per cent of the companies export to worldwide markets.

What type of products are involved? Data from the 1995 survey show that 39 per cent of products are directed at the consumer market and practically the same share (36 per cent) at industrial suppliers. A mere 9 per cent are supplied mainly to public sector bodies.

Companies from all branches of industry are involved in the EcoDesign project, but some branches are especially well represented (**Table 1**).

The share of the wholesale trade is interesting, since this is not an industrial sector. However, developments in the wholesale trade, where suppliers are increasingly taking on the additional role of wholesaler, are prompting companies to market more products of their own.

Why did companies join the EcoDesign project? A survey of the participants in 1995 produced some remarkable data. On one hand, companies feel obliged to make environmental improvements by laws and regulations, for instance agreements ("covenants") concerning packaging, plastics and waste. The legislation in other countries (especially Germany) is also a factor. In contrast to these more or less negative arguments ("we have to"), there are many more positive arguments: two-thirds of the participants expect to increase their market share with the environmentally improved product. Over half expect the improved products to allow them to enter new markets. The same percentage expect to obtain commercial advantages from product innovation.

Environmental improvements

The system developed within the framework of EcoDesign seems to work well. All companies that had an Environmental Innovation Scan found possibilities ("options") to reduce the environmental burden of their product, on average eight to nine options per product.

The outcome of a number of scans has been tested by a team of environmental specialists. They identified practically the same set of options that the IC advisor had found. In this respect, the method has proven to be sound. Differences have nevertheless arisen concerning the choice of the most preferable options: the advisor of the InnovationCentres also takes into account which options are the most promising from an economic viewpoint.

The options found by the 1995 and 1996 EcoDesign participants can be divided according to the strategies shown in **Table 2**. As the table shows, a comparatively large number of options were found in relation to improved functionality of the product. This is encouraging, since that strategy can produce radical innovations leading to major environmental improvements.

"Options", as the term indicates, are *possible* improvements which are basically feasible but whose return and market value have not yet been investigated. The EcoDesign project not only looks at the environmental improvement of products. Products must also be commercially viable. This means that not all options can be realized.

Which options are realized? The survey looked at 73 companies that started with EcoDesign in 1995. Of the 602 options companies located through the Environmental Innovation Scan, 178 were immediately put into practice. Participants think that another 39 options will be introduced within a year. In other words, over one-third of the options will be introduced in the short term.

Options with a high success rate are:

- opt for more environmentally friendly production processes;
- prevent wastage of energy and consumables;
- increase the operational reliability of the product;
- facilitate maintenance and repairs;
- recycle materials where possible.

The extent of the environmental profits directly gained by the project is not easy to investigate. It also depends on the success of the improved products on the market and the extent to which less eco-efficient products are ousted.

As far as the indirect profit of the project is concerned, it can be stated that the knowledge of the participating companies in the field of environmental product development has increased considerably. According to the survey of 1995 participants, 10 per cent stated they were now "very able" to apply independent environmental product development, whereas 26 per cent stated they were "able to do so to a certain extent". In view of the fact that participants had little or no awareness of environmental product development before the start of the project, this result is satisfying.

Almost two-thirds of the companies participating in the 1996 EcoDesign project also intended to apply the system of environmental product development to other products in their range.

The future of the EcoDesign project

According to plans, over the next two years an Environmental Innovation Scan will be carried out for 350 more small and medium-sized enterprises. The number of participants each year needs to increase, but whether this will happen is uncertain. The leading companies, in terms of innovational readiness and environmental awareness, from each branch may already have participated during the first two years of the project. If so, the InnovationCentres' advisors will find it increasingly difficult to bring new participants into the EcoDesign scheme. This is one of the reasons the InnovationCentres are seeking more intensive cooperation with the branch organizations in the field of EcoDesign.

Experience during the first two years shows that the main objective of EcoDesign, to familiarize small and medium-sized enterprizes with the principles of Environmental Product Development, is being achieved. Furthermore, the project leads to many environmental improvements in products. This is only possible thanks to the effort and enthusiasm of the team of EcoDesign advisors in the InnovationCentres.

As an example of the results achieved, this article includes some remarkable product innovations from the EcoDesign project. Not every company realizes such improvements in environmental efficiency and competitive position, but almost every company gains some environmental profit through the EcoDesign project. This, too, is significant. Taken together, many small steps represent a significant improvement: short-term results are achieved and the groundwork is laid for possible leaps forward in innovation.

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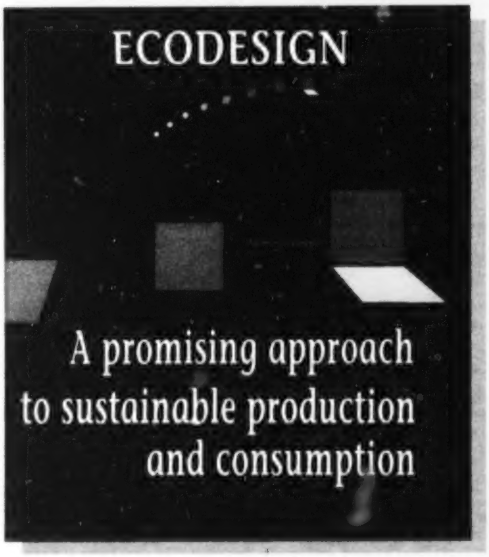
Ecodesign – A promising approach to sustainable production and consumption

Over the past 15 years, UNEP has done much to help industry improve its environmental performance. Attention focused initially on industrial processes, then moved on to environmental management systems. It was then time to address the most fundamental aspect of industrial production: the product itself. In the early 1990s, projects and programmes on environmentally benign product development were initiated and implemented.

UNEP IE, together with the Rathenau Institute, a Dutch technology assessment organization, and the Delft University of Technology, documented, analysed and interpreted the valuable results and experience from these programmes and projects. This work formed the basis of the manual *Ecodesign – A promising approach to sustainable production and consumption*, published in April 1997.

The manual provides state-of-the-art and practical "how to do it" information about this fast-growing, environmentally sensitive approach to product design. It brings together experience accumulated in recent years, since governments, businesses, consumers and non-governmental organizations began to pay more attention to the environmental aspects of products and their design. This experience represents the most recent step in an ongoing process of evolution of environmental approaches: from end-of-pipe (in the sixties and seventies), to cleaner production processes (in the eighties), to cleaner products in the nineties.



ECODESIGN

A promising approach to sustainable production and consumption

Approach

The term "ecodesign" has been chosen for the manual, as it implies the need to find the right balance between ecological and economic requirements while developing products. Environmental issues are considered at all stages of product development, using a step-by-step approach to design products with the lowest possible environmental burden. Throughout the manual the positive effects on sustainable production and consumption are highlighted, illustrated by many examples, checklists, figures, and rules of thumb.

Description of the manual

The backbone of the manual is the step-by-step plan which allows businesses to initiate and carry out their own ecodesign project, and thus to become familiar with ecodesign principles while building up experience in the field.

The organization of an ecodesign project is broken down into seven steps:

Step 1: Organization of the ecodesign project
Step 2: Product selection
Step 3: Establishment of an ecodesign strategy
Step 4: Generating of ideas
Step 5: Detailing of the design concept
Step 6: Communication and product launch.

The seven-step plan is structured to be compatible with many assessment procedures, leading to cleaner processes. Even more important, it is fully compatible with the traditional, systematic product development process. This means that the basic structure of development remains unchanged. Environmental requirements only need to be integrated.

The manual has nine supplementary modules, each covering a specific aspect of ecodesign: ecodesign strategies, optimization of the end-of-life system, methods for life cycle analysis, methods for life cycle costing, ecodesign workshops, green marketing, overview of environmental problems, product-oriented environmental policy, and information providers and literature. The manual is completed by a set of worksheets.

Ecodesign – A promising approach to sustainable production and consumption is primarily intended for product managers, developers and designers. However, it also provides an introduction to the concept of ecodesign for all those interested in product development, in large and small companies or design consultancies. The information presented will also be very valuable to students and teachers of industrial design-engineering, and to those more specifically involved in ecodesign education.

The ecodesign manual does more than just fill the existing gap in the cleaner production knowledge base, which contains a good number of manuals on cleaner processes but hardly any information on how to produce cleaner products. By providing guidelines, examples, and, above all, the practical step-by-step plan, the Ecodesign manual will help speed up the process of ecodesign worldwide and will increase the impact of UNEP's Cleaner Production programme.

FoxFibre naturally coloured cotton: an environmental, economic, and aesthetic advancement

Sally V. Fox, President, Natural Cotton Colours, Inc., PO Box 66, Wickenburg, Arizona 85358, USA

Chances are you are wearing clothing made from a wonderful natural fibre known as cotton. It is comfortable, biodegradable and recyclable. It is also 100 per cent natural ... or is it? Unfortunately, what should be an environmental success story may actually be a serious problem.

The majority of cotton grown worldwide is produced with pesticides to control insects, diseases and weeds, and defoliants to facilitate harvesting. In most areas, cotton production consumes more pesticides than every other agricultural crop. In countries where chlorinated hydrocarbon insecticides (DDT, dieldrin, aldrin, lindane) have not been banned, they are manufactured and used on cotton. Residues of these insecticides are commonly found on textiles manufactured from this cotton. In the United States, which has relatively strict environmental standards, over 544,690 metric tonnes of synthetic chemicals (active ingredients only) were used for cotton farming in 1992. Because it is not normally used for human consumption, many pesticides deemed unsafe for other crops are commonly applied to cotton. Many of the synthetic fertilizers commonly used on cotton have migrated to the water table and pose serious health risks.

Once the cotton is grown and ginned, the textile processing necessary to provide the colourful fabrics everyone wants requires the use of numerous environmentally dangerous processes. The dyeing and finishing processes consume huge amounts of energy and water mixed with formaldehyde, dyes, and other chemicals. In the US and some other countries, most of the resulting wastewater is cleaned at great expense and not released directly to the environment. In much of the world, however, it is not cleaned and is dumped directly into the environment.

Sally Fox, founder and president of Natural Cotton Colours, Inc., had a better idea to keep cotton natural. Breed cotton that naturally grows in colours and farm the crop organically. Sounds easy, but it took years of plant breeding to combine the beautiful colours of wild cottons with some of the superior fibre and agronomic properties of commercial white cottons. Coloured cottons have always existed in nature. Native peoples have used their short fibres for hand spinning and weaving. Modern plant breeders have used them as a source of desirable plant characteristics such as disease and pest resistance. The fibre itself has never been improved and was not spinnable with modern textile machinery. Starting in 1982 with wild coloured cotton seeds she obtained from public seed banks, Sally began to develop improved varieties. After many years of work, she developed the first naturally coloured cotton that could be processed on modern textile machines.

Sally's plant breeding nursery has always been organic, so natural selection (and Sally selection) has resulted in tough plants that, with the help of sound farming practices, can fend for themselves without the use of synthetic pesticides on certified organic farms.

During textile processing, FoxFibre® naturally coloured cotton completely eliminates the use of dyes, formaldehyde, and other harsh processing chemicals. Even so-called "low-impact" dyes are unnecessary. Finally, truly organic textiles are possible. By blending FoxFibre® cotton with white cotton, many beautiful earth-tone shades of brown and green may be produced. All FoxFibre® cottons have the unique property that the colour actually intensifies when the fabric is washed. Not all naturally coloured cottons have this property.

What about the economics? A bale of FoxFibre naturally coloured cotton does cost more than white cotton. The additional cost, however, is more than offset during textile processing because all of the dye and most of the finishing steps are eliminated. Because of the colour intensity of these cottons, most yarns made with FoxFibre® cotton are blended with white cotton, so the economics are even better.

As an example, a khaki fabric made with FoxFibre® naturally coloured cotton should be 27 per cent less expensive to produce as compared with a dyed khaki fabric produced in an environmentally responsible mill. A certified organic khaki made with FoxFibre® naturally coloured cotton should also be less expensive than a non-organic dyed khaki (10 per cent savings).

In a very significant new development, Natural Cotton Colours has recently received a patent for the natural fire resistance properties of its brown FoxFibre cotton lines This cotton can be used to produce fabric that complies with flammability safety regulations without application of a flame retardant chemical, or with application of reduced amounts of flame retardant chemical.

Natural Cotton Colours, Inc. has conducted extensive spinning, weaving and knitting tests over the years and has developed expertise that is available to new customers wanting to work with these fibres. This cotton processes like any other cotton, but its unique properties allow mills to produce beautiful effects not possible with traditional dyes. Our efforts have resulted in many different uses for FoxFibre® cotton.

FoxFibre® naturally coloured cotton has already been used in many products around the world. Levi Strauss produced a wonderful line of jeans. Jockey International is producing underwear. It is perfect for sheets and towels. The natural fire resistance properties open many opportunities for upholstery and bedding. IKEA Furniture is pioneering its use in organic upholstery. The cost benefits of commodity fabrics such as khaki could result in an explosive growth potential.

The environment and the consumer will benefit from this wonderful new product. *For more information:*
Tel: +1 520-684-7199
Fax: 520-684-7299,
E-mail: sally@foxfibre.com, www.foxfibre.com/cotton

Product stewardship at Rank Xerox

Hugh Smith, Manager, Environment, Health and Safety and Joint Venture Operations, Rank Xerox Manufacturing and Supply Chain, Rank Xerox Limited, Parkway, Marlow, Buckinghamshire SL7 1YI, UK

Abstract

One of Rank Xerox's main corporate goals is "Waste Free Products and Waste Free Facilities". Rank Xerox has studied the life cycle of its products and the possibilities for reuse of recovered equipment for a number of years. Customer acceptance of products that contain reused or reprocessed parts will be necessary in order to achieve the goal of "Waste Free Products".

Résumé

L'un des principaux objectifs de Rank Xerox peut se résumer à cette formule : des produits et des installations sans déchet. Rank Xerox a étudié le cycle de vie de ses produits et les possibilités de réutiliser pendant plusieurs années les équipements récupérés. Pour atteindre l'objectif de "produits sans déchet", il faut que les clients acceptent d'acheter des produits contenant des pièces récupérées ou réusinées.

Resumen

Uno de los objetivos principales de la empresa Rank Xerox es "Productos sin residuos e Instalaciones sin residuos". Rank Xerox ha estudiado el ciclo de vida de sus productos y las posibilidades de una utilización repetida del material recuperado durante varios años. Se requerirá que los clientes acepten los productos que contienen piezas recicladas o reprocesadas con el fin de lograr el objetivo de "Productos sin residuos".

Background

As "The Document Company", Rank Xerox supplies a complete range of document processing equipment and services dealing with all aspects of document life cycle management from creation and manipulation to distribution, printing and storage.

Introduction

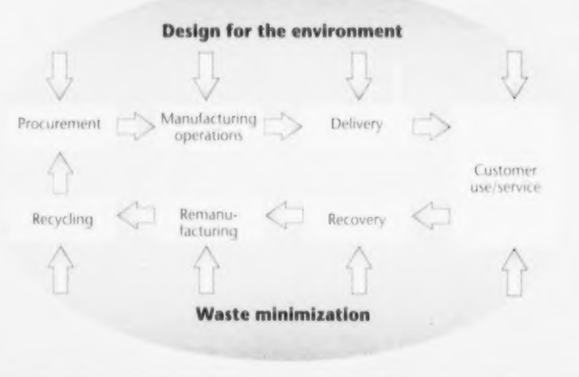
Product Stewardship is not a new concept in Rank Xerox, where equipment and parts have been recovered from customers at end of use and reprocessed in a variety of ways for nearly 40 years! However, although the underlying philosophy of resource conservation and environmental impact reduction was as valid in the 1960s as it is today, the concept has expanded considerably in today's context to encompass life cycle and environmental impact assessment at all phases of the product life cycles and now includes the impacts of our operations not only in our manufacturing plants but also in our design and development centres, administrative offices, and sales and service operations worldwide.

The early days of tactical initiatives for parts and equipment recovery have progressed to today's strategic programmes, which are established to meet current and outlooked customer requirements, to anticipate future environmental regulation and industry standards, and to maximize asset utilization through Design for the Environment principles and waste minimization programmes.

These early recovery programmes were implemented either for safety and environmental reasons, such as photoreceptor recovery, or for business reasons, to supply the demand for refurbished equipment and to support the service activities through spares supply.

It wasn't until later years that it was realized that similar programmes could be utilized to strategic advantage by assisting the fulfilment of one of the corporate values – "to behave responsibly as a corporate citizen" – and through so doing place the company in a leadership position in front of the rising tide of customer and public awareness of the environment.

Figure 1
Integrated Supply Chain



This approach clearly cannot be derived from corporate ethos alone. The culmination of, and motivation for, improving environmental performance is the improvement in customer perception not only of our products but of the corporation as a whole, leading to customer preference and competitive advantage. Our experience has been that designing environmental performance into products and operations also leads to reduced costs in the longer term, enabling the delivery of improved value to customers. This customer focus results in product stewardship being firmly embedded in the business management process and not solely championed by environmental specialists.

One of the strategic goals for Rank Xerox can now be simply stated as "Waste Free Products from Waste Free Facilities".

Product Stewardship

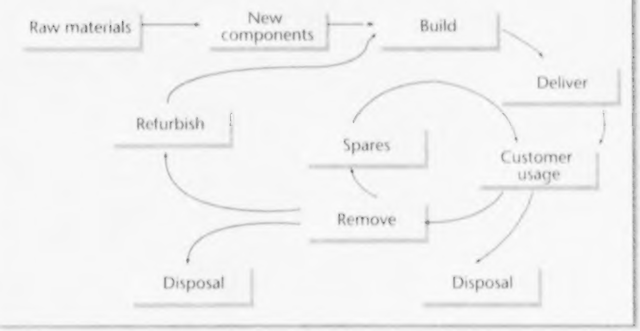
The embodiment of Product Stewardship in the corporation has at its core the Integrated Supply Chain (ISC), as shown in **Figure 1**, supported by Design for the Environment principles (discussed later) and a comprehensive Waste Minimization programme throughout all stages of the product life cycle. The key to effectively closing the loop in the ISC is the remanufacturing process, the development of which in 1993 provided the breakthrough towards establishing the strategic foundation for product stewardship.

The remanufacturing process

The Integrated Supply Chain has its roots in the days when Rank Xerox was the only supplier of plain paper copiers and there was a buoyant market for refurbished equipment. The copiers were mainly rented, and an extensive logistics infrastructure was developed to support both the supply and service requirements and to provide the means to recover equipment at end-of-use. At this stage the product life cycle was as shown in **Figure 2**, which demonstrates the rudimentary closed loop which existed even in the 1950s and 1960s.

As competition and technology brought new equipment prices down, the demand for refurbished equipment declined. As a consequence, the efficient returns process led to end-of-use equipment being returned to the manufacturing sites but now without significant prospects of their returning to the market. Rather than disposing of these

Figure 2
Rank Xerox historical product life cycle



assets, a cross-functional team was given the remit to develop a strategic solution – and the Remanufacturing Strategy was conceived. Under this solution, end-of-use equipment would be dismantled rather than repaired, and parts would be reprocessed, tested to "as new" performance specifications, and rebuilt and performance tested on manufacturing lines which were integrated with the new build lines. **Figure 3** shows this as a product life cycle schematic. This concept predated the current philosophies of Product Take-Back and Producer Responsibility with which many manufacturers are trying to come to terms today.

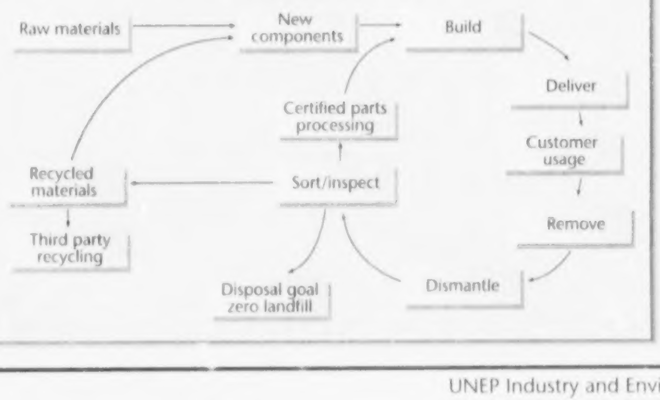
The benefits attached to such a process were manifold: an end-of-use collection process for customers, effective utilization of the asset base, considerable reductions in waste to landfill, the avoidance of raw materials purchase and their associated energy usage, and the ability to supply environmentally sound equipment to the market.

Savings on the purchase of new materials alone amounted to over £50 million in Rank Xerox last year, in addition to turning a potential disposal cost into a revenue stream.

There were, however, significant business issues to overcome associated with the marketing of any equipment which contained reprocessed parts. These obstacles were related to the perception of these products by the customers in the marketplace, and to the contractual definition of "new". The latter issue was overcome by the establishment of dual product lines defined as Newly Manufactured – flagship products incorporating the latest technologies and features which may contain a minor proportion of reprocessed parts – and Remanufactured products with the majority of parts being reprocessed. The main issue to be addressed was how to change the customer perception of such products as being "not new" and therefore undesirable, when the performance and quality were demonstrably as good as new.

The solutions lay in building customer confidence. Firstly, the industry unique three-year "Total Satisfaction Guarantee" – the same as that given on new equipment – was offered on remanufactured equipment to demonstrate our confidence in the products. Secondly, we embarked on a campaign of open communications during which we had extensive press coverage from manufacturing plant open days for customers, the media, academics, government and European Union representatives, and even competitors! Conference and seminar papers were also presented, all to demonstrate the quality and soundness of the processes adopted and to bring about the start of a cultural change and general acceptance that this was the "right thing to do" and was the future direction needed to address environmental concerns provoked by end-of-life product disposal.

Figure 3
Rank Xerox current product life cycle



It became apparent during the development of this remanufacturing strategy that a further ingredient was essential when embarking on such pioneering initiatives – that of a committed and visionary senior management. As can be seen from the previous discussion, there were many pitfalls and unknowns which had to be confronted before taking the leap in the dark. The decision was taken, however, and the success of the products was better than anticipated, with demand exceeding the plan by 50 per cent last year – only three years from its inception.

The ultimate accolade was given to the programme in 1996, when Rank Xerox was awarded the European Better Environment Award for Industry in the Recovery of Waste category, presented by the then President of the EU, Mrs Mary Robinson, in Dublin.

Associated benefits

Many other benefits were gained from the implementation of this strategy. The success of the programme in closing the Integrated Supply Chain loop and the attendant publicity gave renewed impetus and focus to all the environmental activities of the company. The Product Stewardship concept became a reality, with feedback from the Asset Management Operations reinforcing and refining Design for the Environment and waste minimization becoming a focus of attention, leading to significant landfill reduction (over 70 per cent in the last three years; see **Figure 4**), packaging elimination (saving over £4 million cumulatively), and waste materials recycling now running at around 90 per cent.

One of the aspects of environmental leadership which is increasingly finding voice is the area of Social Responsibility, where many are grappling with what this really means. An unforeseen bonus, therefore, was the employment of an additional 400 people in the various manufacturing sites on product disassembly, parts reprocessing and remanufacturing of products. Careful equipment disassembly and parts reprocessing is labour intensive due to the variable nature of the input material. Different configurations and options are unavoidable due to the largely unplanned returns mix from customers.

Employee involvement and ownership of environmental responsibility increased dramatically, leading to improvements which would not have been possible through management attention alone. These achievements are shared throughout the organization through communication and an annual programme of "Reduce, Reuse, Recycle" awards to teams and individuals who have made outstanding contributions in this field. Successful projects cover the entire spectrum of the environment: resource conservation, environmental leadership, source reduction, community involvement, energy conservation, technological innovation, and a category for special recognition.

Design for Environment

The success of remanufactured equipment in the marketplace gave much impetus to the application of Design for Environment (DFE) principles in order to maximize the ability to recover and reuse parts from future generations of machines, thus transforming the remanufacturing programme from an "end of pipe" to a "clean technology" process. Furthermore, full product stewardship requires a much broader approach than concentrating on reprocessing abilities alone.

Anticipating the development of customer and regulatory environmental requirements is essential to maintain market competitiveness, where the impact of the equipment whilst in use is of major importance. Noise, heat, dust, ozone emissions, safety, ergonomics, power consumption, and electromagnetic emissions and susceptibility are all factors which have to be considered and constantly improved upon, often requiring the development of new technologies and materials and frequently setting the standards by which the industry is measured. For example, Rank Xerox was the first company to introduce energy-saving modes and double-sided copying in the 1970s, both of which are now basic requirements for copiers. Issues such as Transfrontier Shipment of Wastes, the Packaging Waste Directive, and eco-labeling all have to be integrated into the design considerations.

Within these extremely tight performance specifications, environmental design begins by choosing a minimal number of materials from the Rank Xerox Material Environmental Index to simplify material segregation and ensure that hazardous materials are avoided. The Index specifies a material's environmental compatibility and helps designers choose non-toxic materials such as thermoplastics and metals. Such durable materials typically experience little wear during normal use and lend themselves well to reuse and recycling.

To ensure that equipment and components do not end up in landfill, they are marked with recycling symbols and remanufacturing codes which detail the recycling and reuse potential and strategy for specific parts. Every new part drawing now has to have the end-of-life process instructions described at the design stage. Where possible, high post-consumer waste content materials are used, such as in plastic cartridge components where recovered cartridges are ground down and the plastic remoulded into new components.

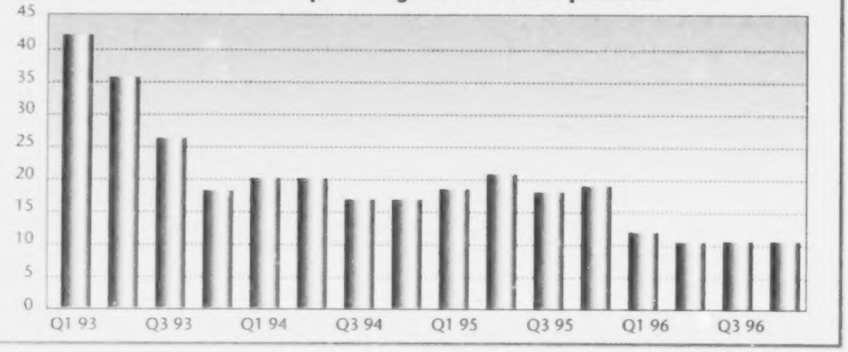
DFE considers product disassembly as well as assembly. Components are consolidated and standardized as much as possible between product families, thus simplifying and optimizing the opportunities for reuse. Many parts are now designed to snap or screw together, rather than welded or glued, making them easier to service and remanufacture. Parts are designed to allow easy cleaning without blind holes and areas which lead to water retention.

Manufacturing processes also have to be carefully chosen to reduce the need for hazardous chemicals or emissions. Solvent-based cleaning and painting processes have been eliminated, substituting water based processes. Class I Ozone Depleting Substances were eliminated from manufacturing and service materials as far back as 1993.

This ongoing activity requires the development of a range of options for reprocessing, shown in **Figure 5** as the nested series of closed loops where parts and materials are reused and recycled both internally and through our supplier base. Although the inner loops are now well established within the company, the outer ones are still in their infancy. The implementation of remanufacturing and reprocessing by our suppliers is another culture change – perhaps of equal magnitude to the extension of supplier quality programmes in the 1980s. Quality was initially seen as an expensive burden, but turned out to be a cost reduction opportunity for most companies, and it is likely that similar opportunities will present themselves as a result of proactive adoption of product stewardship.

At the same time, as a result of putting in environmental management systems at the manufacturing plants, a supplier environmental assessment programme is being implemented on a global basis to ensure that our suppliers develop and maintain a broader environmental responsibility in line with our own objectives.

Figure 4
Landfill as a percentage of total waste produced



A waste-free environment

As mentioned in the introduction, the amalgamation of these programmes under the banner of product stewardship has come to be simply described within the company as one of our main corporate goals: "Waste Free Products from Waste Free Facilities".

In the factories, health, safety and the environment are integrated into the day-to-day management processes. Waste is an anathema, whether it be of resources, time or effort. Environmental management systems have therefore been developed to give the line managers a structured approach to waste minimization and environmental risk and impact reduction. Both the main manufacturing sites now have EMAS accreditation to demonstrate further our commitment to the Rank Xerox model for product stewardship and to provide the continuous stimulus for environmental performance improvement.

Waste Free Facilities not only means waste-free factories, but extends to waste-free offices and is now reaching out into waste-free customer offices. Using our own energy-efficient equipment running with Xerox environmental and recycled papers, the waste-free philosophy was applied to the office environment, supported with the introduction of paper segregation and recycling, plastic cup and drinks can recycling, and a pervasive energy conservation culture. Realizing the benefits this can bring to any office in terms of cost and efficiency, the waste-free concept has been extended to cover customers' premises. Rank Xerox naturally knows more than most about the document management process and is able to apply that knowledge to customers' complex documentation processes, such as those in the drugs and aircraft industries. Rank Xerox know-how is combined with hardware and software to produce integrated systems solutions by re-engineering these processes from basic principles to reduce waste – wasted time, errors, and complexity.

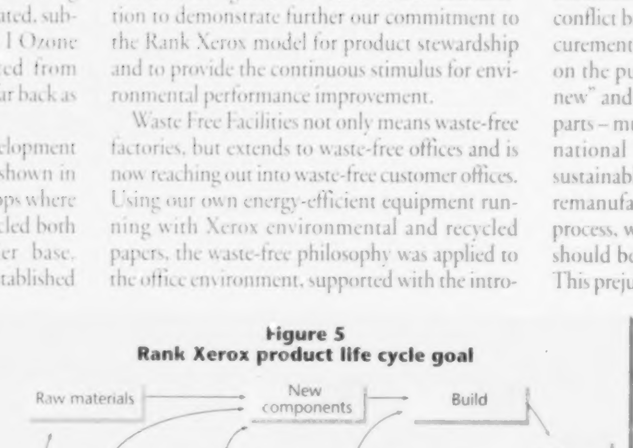
In conclusion

Despite the apparent success of all that has been done, there still remain obstacles in gaining full acceptance of the application of product stewardship. This is most noticeable in the public procurement arena, where there is still a major conflict between thoughts and deeds. Public procurement contracts in many countries still insist on the purchase of equipment which is "brand new" and does not contain reused or reprocessed parts – much at odds with the stated intentions of national governments and the EU towards sustainablility. This has the effect of precluding remanufactured equipment from the tendering process, when performance and value for money should be the over-riding criteria for selection. This prejudice is being pursued through the European Commission. In some countries our right to tender is being vigorously defended through the judicial system, where it is being legally challenged by our competitors. Perhaps, paradoxically, this action is a major testament to the viability of our approach and will signal the death knell of outdated and unsustainable thinking.

Rank Xerox is now moving to eliminate the distinction between new and remanufactured parts and equipment, to the point where equipment is judged on its output – The Document – and not the means by which it is produced.

◆

Figure 5
Rank Xerox product life cycle goal



Life cycle design of a telephone

Carlo Vezzoli, CIR.IS-UR.PS, Interdepartmental Research Centre, Innovation for the Environmental Sustainability Research Unit,
Product and Services DI Tec Dept., Polytechnic University of Milan, Via Bonardi 30, 20133 Milano, Italy

Introduction

Increasing environmental pressures mean that design can no longer be viewed as an isolated activity. The design process must take account of the relationship a product will have with the environment throughout its life. In other words, products must be developed using a life cycle approach.

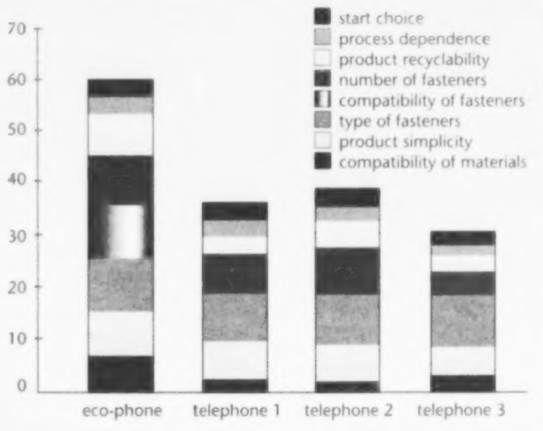
This case study, of the redesigning of a telephone with basic functions, forms part of a wider investigation by the University of Milan's Interdepartmental Research Centre, Innovation for Environmental Sustainability Centre (CIR.IS) into methods and tools for the development of sustainable products. The project was developed with the support of the Department of Plastics and Environment of the Finnish Industrial Group Neste Oy, and the Telephone Division of the Danish company Bang and Olufsen .

The project had two aims: to apply a Life Cycle Design (LCD) approach to redesigning a product in order to extend its working life and that of the materials used, so as to reduce overall environmental impact, and to evaluate the methods and tools used.

In redesigning the telephone, an analysis of all life cycle phases was made covering performance, technological, economic, cultural, psychological, aesthetic, and of course environmental aspects. The priority areas for environmental improvement were identified as use (product life extension) and disposal (material life extension).

Based on this analysis, an environmental requirements framework was established which, in turn, was used to produce an effective set of strategies and guidelines. Several environmental design options were then compared with one another and with other product system requirements, and a final design proposal was produced. This was evaluated from the environmental and economic points of view, and a 1:1 scale model built. The main advantages of this eco-conscious design process are summarized below.

Figure 1
MMU indices of disassembly and recylability



Reduction in use of natural resources

Based on the pre-production and production stages of the product's life cycle:

- recycled ABS was used for the telephone body and for internal plastic components;
- a textured surface pattern was used to reduce the visibility of superficial defects and scratches, reducing rejects during production and by users.

Design for disassembly

Design for disassembly is relevant to the extension of the life of the product (maintenance, repair, reuse of product and/or components) and the life of the materials (recycling and incineration). The following design features were incorporated:

- sandwich structure;
- assembly/disassembly sandwiching, replacing internal screws, stud-welding and adhesives for fixation of subassemblies such as the microphone, loudspeaker and cable jack in the handset, and the wire board, ringer, keys and cradle on the phone body;
- holes allowing the circuit boards to be snapped in and out;
- single-snap fittings with hooks for both phone body and handset casings (easy, fast, and avoiding the use of screws or metal inserts);
- facilitation of the disassembly of both the phone body and handset by making tool points easily accessible;
- simplified visual disassembly guide which is an integral part of the base moulding.

Design for recycling

The following features extend the life of the materials:

Compatibility. In this context, compatibility means the possibility of recycling the phone body, handset casings, keys, commutator, numbers label, display and pressure feet in the same stream for the production of new telephone bases and internal parts. The phone body, handset casing, keys, commutator and numbers label are all made from ABS; the phone base and internal components are made from recycled ABS; and the numbers display is made from transparent ABS or SAN.

Easier cleaning. To facilitate cleaning of materials, coloured polymers are used. To avoid surface painting, surface markings on keys are made using laser techniques and the telephone nameplate is embossed on the handset.

Identification of materials. Information specifying the polymer type, age, number of completed cycles, additives used, and disassembly path is given in a bar or standard code which is an integral part of the moulding.

Assessment

A life cycle assessment focusing on material alternatives was carried out, mainly using the PWMI database in the inventory phase and CML and modified BUWAL methods in the evaluation phase. Several disassemblability and recyclability indices, provided by Manchester Metropolitan University, were used. These showed that the redesigned telephone was a marked improvement on other telephones currently on the market. This is illustrated by **Figure 1**.

Total cost curves for disassembly and recycling processes revealed interesting opportunities, especially relating to the exponential increase of reject costs, future automation of disassembly, and internalization of end-of-life costs.

Conclusion

Assessment of the design methodology used to redesign the telephone was positive, but it also showed the need for improvement of tools for environmental design and of the methods for integration of environmental requirements into the design process.

The indices were easy to use and were useful for verification and communication of improvements. However, they appeared inadequate for actual product development. On the other hand, the use of focused LCA methods gave complex results which were nevertheless useful in the selection of materials during product development. Problems of data quality and reliability of evaluation highlighted the need for more research in the field. A project for an Italian LCA database was started recently at the CIR.IS, commissioned by the Italian Environmental Agency (ANPA).

Another project started at the same time has the aim of producing an educational multi-media software tool for the development of sustainable products.

Introducing the EDEN Eco Profiler

Yorick Benjamin, Senior Researcher, UNEP-WG-SPD, and Director, EDEN (Environmental Design for Ecological Need), Dewittenkade 93 HS, 1052 AE Amsterdam, the Netherlands

Abstract

Product design is very information-intensive. The "EDEN Eco Profiler" is designed to assist a wide range of users (such as designers, policymakers, legislators, regulators, industry and SMEs) realize cleaner production objectives. The Profiler can be used to organize and manage the enormous amount of information available on the environment and create environmental profiles specific to individual needs. The "Profiler" is flexible enough to support sustainable production and consumption activities in both developed and developing countries.

Résumé

Le design des produits suppose la prise en compte d'un nombre considérable d'informations. "EDEN Eco Profiler" a été conçu pour aider divers utilisateurs (designers, responsables politiques, législateurs, organismes de réglementation, industriels et PME) à atteindre les objectifs de production plus propre. Il permet d'organiser et de gérer l'énorme masse d'informations sur l'environnement actuellement disponible, mais aussi de créer des profils d'environnement adaptés aux besoins de chacun. "Profiler" est suffisamment souple pour soutenir les activités de production et de consommation durables dans les pays développés comme dans les pays en voie de développement.

Resumen

El diseño de producto requiere un máximo de información. El "Perfilador ecológico EDEN" está diseñado para ayudar a un amplio espectro de usuarios (como los diseñadores, políticos, legisladores, organismos de control, la industria y las PYMES) a lograr sus objetivos de producción más limpia. Se puede emplear el Perfilador para organizar y dirigir una importante cantidad de información disponible en el medio ambiente y crear perfiles medioambientales específicos para las necesidades individuales. El "Perfilador" tiene la flexibilidad suficiente para otorgar actividades de producción y consumo sostenibles tanto en los países desarrollados como en aquellos en vías de desarrollo.

Introduction

In order to debate, and exchange ideas about, environmental concerns, NGOs, government and industry have to use some form of measurement "tool" much of the time. This has led to methods such as LCA and EMAS, through which goals and targets can be identified and agreed. Methods such as these provide the basis for controlled discussion between the different actors. They are also the tools used to measure environmental improvements, once a consensus has been reached between different stakeholders. Without such tools, the objective of moving towards cleaner production will be inhibited by debate based on emotion and different ideological perspectives.

A common feature of many of these tools is that they aspire to be based upon quantitative measurement. However, it can be argued that measurements of environmental impacts are rarely factual and quantifiable (apart from very controlled studies of an inventory nature), and that there is a place for a tool that works with the qualitative nature of many of these issues as well as with those that are clearly quantifiable. In taking this stance, studies can be more informal, based on common sense, and specific to users' needs. If this approach is balanced with the opportunity to use agreed frameworks such as EMAS when desired, a very useful tool can emerge.

The "Profiler" meets this need, as it has been developed to manage and measure subjective and qualitative concerns as well as quantitative ones. It can fit specific user needs for quick screening of a problem, or be used for in-depth studies. The Profiler is not so much a specialized environmental tool as a powerful information manager, which makes it especially useful for information-intensive tasks such as environmental studies.

The Profiler allows users to define their own system boundaries for an environmental study and develop profiles tailored to their own requirements. The system is designed with the assumption that users are best placed to develop an environmental profile their own activities. The user controls the method used, the information gained, and the scores that result, in an informal valuation for in-house use.

When using the Profiler, it is simple to carry out quick scans since the user can clearly attribute a "qualitative" symbol to the environmental "profile" being developed. Therefore, the user is not stating that the profile given is the "answer", but that the profile score given is based upon the knowledge and resources available, e.g. data sources, time committed, researchers available, budget, etc. It is of course up to the user (e.g. a company) to decide who has access to the data. Nevertheless, the "openness and accessibility" of the data used to obtain a profile score mean that results are open to scrutiny and can be discussed.

More formal valuations (for public disclosure) can also be undertaken, as the Profiler can present "reference profiles" to support the user. Reference profiles are intended to contain internationally recognized methods such as ISO standards and EMAS (to be implemented). The profile is developed by using the "reference profile" as a guide as well as for goals and targets.

Users of the Profiler will therefore be able to develop new environmental studies, use existing in-house techniques, or take advantage of internationally recognized methods such as EMAS, ISO 14000, etc. The Profiler has been designed in this way because many industries, standards organizations and consultants have already developed important techniques for use in working on environmental studies. The Profiler facilitates this valuable expertise, in which investments have already been made. It is the means of exploring, organizing, transferring, and sharing information between all the stakeholders. Until now much of this valuable environmental information has resided in different collection systems and has been inaccessible and unusable – in fact, it can be said that there has been a problem of information chaos.

Profiler background and development process

Qualitative concerns

The Profiler design has its origin in exploring information "types", LCA, and the design process. Particularly important in this approach is the relationship between the weighing of environmental impacts and the process of giving an understandable and usable aggregated value to the end user.

This is an ongoing debate. A simple graph has been proposed that demonstrates the qualitative nature of many of the issues we attempt to measure and gives weighted values to environmental studies (**Figure 1**). The vertical axis of the graph represents the various categories of the impacts analysed in an LCA study. The horizontal axis represents the degree of aggregation (valuation) conducted across the various categories. It can be seen that, as the number of categories considered increases, the possibility of presenting a credible aggregated and quantitative value decreases.

The ideal would be to present a single answer which totals all the impacts and valuations (shown in the top right corner). However, this objective is far from being reached.

Other practical concerns related to the nature of LCA helped form the thinking behind the Profiler:

- Multi-criteria assessment is value-laden, and consensus among experts on how to make direct comparisons between different types of impact is unlikely to be realized.
- The LCA approach requires considerable data to support its findings, but there is little information in the public domain which is reliable or available.
- The criteria on which information is supplied are still a subject of much debate.
- LCA boundaries of assessment of internal and external environmental impacts are not defined.
- Considerable costs are involved with LCA, particularly for SMEs.
- A great deal of expertise is required in order to undertake such a study.

The exploration of LCA reinforced the opinion that many of these issues are of a qualitative nature. This viewpoint was strengthened by examining ecodesign work from an industrial design perspective. The work highlighted the general and environmental information problems that designers face, and helped in the formulation of the Profiler design.

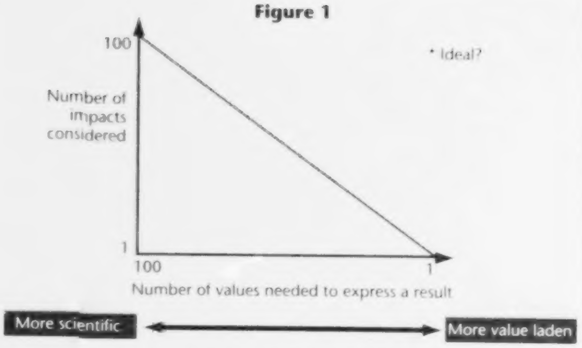
The designer process

Industrial designers (particularly consultancy-based ones) consider many criteria. They make decisions quickly regarding a broad number of issues. They are not in a position to focus on a single concern for any length of time, as the design process involves the integration of so many elements. Furthermore, there can be little room for set and detailed environmental rules, as there are many ways to design/make the same product – consider the range of cars or hi-fis, for example. The marketplace also demands different sorts of products that serve the same function, each of which has different environmental consequences. Much of the time subjective design judgments and practical non-quantitative constraints, such as the concerns of others, determine the design direction.

In the design process there are a great many issues to be evaluated, and there are many ways to evaluate them! Product design is a very information-intensive task. Once cleaner production concerns are integrated into the process, even more information is required.

This means designers are very often generic information-seekers. It follows that the environmental information they require will usually need to be generic as well. Information generally comes from many different sources. It is often qualitative and difficult to access, manage, and present to others.

Figure 1



Adapted from: A.A. Jensen, 1992, SETAC Europe Life Cycle Assessment Workshop, Leiden, NL

Specifying the profiler design

After LCA, ecodesign, and the design process had been considered, the Profiler software was developed on paper and specified in a research report commissioned by the European Foundation for the Improvement of Living and Working Conditions. The original design specification stated that the Profiler should be able to:

- organize, assign and weight values associated with information gained by a user;
- be very transparent in regard to how results are achieved;
- allocate different information types to each weighted value shown;
- manage multi-criteria issues across the whole life cycle of processes, products and packaging;
- present information in the form of a graphic profile which is supported by a written archive;
- access information sources such as the World Wide Web and LCA databases;
- integrate reference profiles in the form of ISO 14000, eco indicators, ecolabels, etc.

In short, it should manage data flows in order to produce environmental profile scores in a transparent manner.

The European Foundation is an advisory research agency to the European Commission, which also backed the development of an early software prototype. The software developers Continuum ID supported EDEN with design and development to bring the Profiler into being. The prototype was evaluated at the "European Workshops on Eco Products" at the European Foundation, Ireland, in 1995 by 67 multi-disciplinary participants from all over the EU. Questionnaire results from the workshops were very positive. For example, 72.7 per cent either agreed or strongly agreed that "I would like to use the Profiler in my work". Development work on the Profiler application itself was carried out during 1996.

The specification has led to a tool that is very flexible. On one hand, it could be used to audit and present specific material savings linked to, for example, a "take-back" scheme. On the other hand, it could be used to develop an energy audit for a camera or even as a "brainstorming" tool for a broad sustainable production and consumption scenario. However, it is important to note that using the Profiler is not intended to be an exact science. It is based on the belief that measuring environmental impacts is a qualitative process. Therefore, the software is called the "Profiler" because the term captures well the nature of the tool:

> Profile = drawing, silhouette, or other representation... an outline.

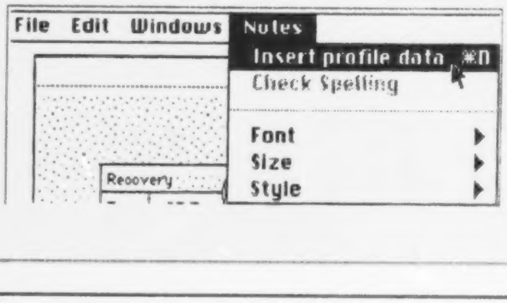
Overview of main features

The Profiler is a flexible graphical software application that supports the organization, scoring and dissemination of information in an easy manner. It is ideally suited for assessment and analysis purposes, including evaluation, decision support and benchmarking, by enabling the user to subdivide complex problems as a starting point. Once a cleaner production subject has been subdivided, the user can collect information using the Profiler via the Internet (and other sources) to support decisions on what score should be given to each subdivided topic. Seven key features of the Profiler are:

1. subdividing complex problems into "Topics" to make them manageable;
2. graphic interface that produces "Profile Patterns" for visual access to the main study criteria and percentage scores;
3. percentage scoring (0-100 per cent) attached to graphic icons which denote a quantitative, qualitative or inference bias;
4. a detailed "Notes" facility to comprehensively support the profile pattern scores;
5. "Linking" of profile patterns in hierarchical order so that scores can be aggregated;
6. superimposition of "Reference Profiles" over the user's own (based upon recognized standards or in-house criteria), so that comparisons can take place.
7. the input of any type of information, e.g. from telephone interviews, WWW searches, LCA inventory databases, etc., to be included in the cleaner production study.

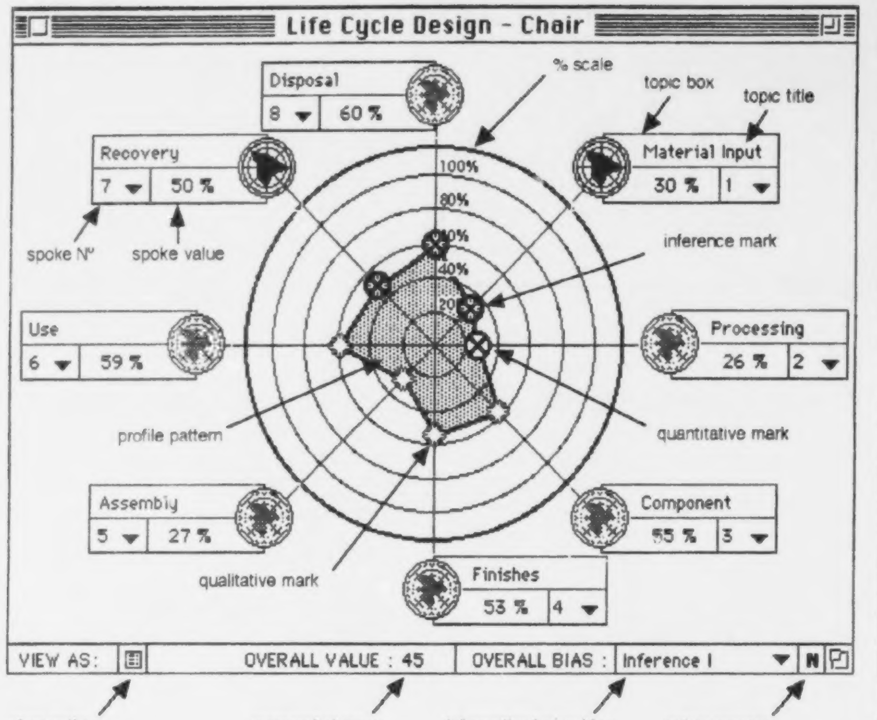
Each feature is described in more detail below. An example of the use of these features is also given, based on a fictitious chair manufacturing company.

Figure 2



Profile patterns and 'Notes' are connected to provide a comprehensive study tool.

Figure 3



1. Subdividing complex problems into topics

It is often best to break a complex problem down into smaller, more manageable parts. This principle is intrinsic to the Profiler application. In taking this approach, it is possible to rationalize a vast range of diverse and often unreconcilable information into a meaningful format which can be clearly presented. The Profiler is hierarchical in nature and enables the user to present an overview of a project with its key criteria (topics) and aggregated scores. These are shown in the "primary profile". Any of these criteria (topics) can be explored in greater detail by either examining or developing profiles underneath the primary profile and linking to it.

2. Graphic interface-profile patterns

The Profiler creates star-shaped profile patterns for a given subject. These patterns are a way to obtain an overview of all the issues. There can be from three to 16 points in a profile pattern. Each point is identified in a "topic box" – the names of the points form the criteria of the subject being studied, which will be scored on a percentage basis (0 to 100 per cent). One profile pattern can overlay another.

3.Percentage scoring and value bias

The scoring system is based on 0 to 100 per cent, with the default value being 30 per cent. The user can determine the percentage score at will, as long as the score (topic) is not linked to another profile (see: 5. Linking profiles). In that case the score is locked until the user determines otherwise. Scoring is aggregated on a bottom-up principle. The primary profile shows the aggregated score from all lower profiles connected to it.

As the study develops, each point can be labelled to indicate whether its score is based on values and information that are "qualitative", "quantitative", or a combination of both: "inference." It is very simple to adjust both the various percentage scores and the labels of a profile pattern by moving it along the "spoke".

The profile pattern, percentage score and "bias" icon all provide an overview. However, in order to be truly useful the Profiler also has a text-writing facility called "Notes" for more in-depth information.

4. Detailed "Notes"

The "Notes" facility is where in-depth information on a "topic" can be recorded. It is also the place where the user will define exactly what the boundaries of the study are: whether it is a cleaner production inventory, assessment, or a combination, whether it is based on a recognized standard or on in-house criteria, the extent of the study, who carried it out, etc.

In addition to this information, which contextualizes the study, the "Notes" facility imports all the scores from the Profile pattern being generated (**Figure 2**).

Every topic being audited or assessed can be supported with text-based data. Therefore, every topic can have an extensive text-based record that justifies and describes the process that went towards its percentage score and bias.

5. Linking profiles

The value of a "topic" can be determined by the aggregate score of another profile by linking them together. This powerful feature allows profiles to be linked 48 levels deep and enables different stakeholders in the development of a "cleaner production" product to contribute to a larger study (chain management). For example, a chair manufacturing company could ask its timber suppliers to provide profiles on all the life cycle stages

Figure 4

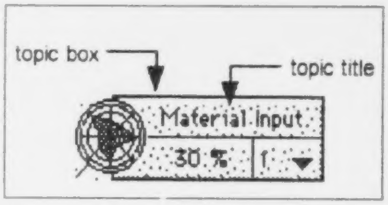
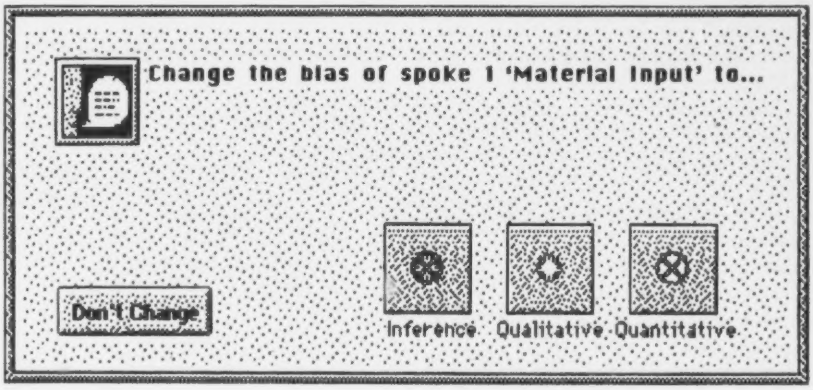


Figure 5


Change the bias of spoke 1 'Material Input' to...

of the timber supplied up to the point where it is made into a chair. The chair manufacturing company could then add this "profile set" to a much larger study on the chair.

In this way the design of the Profiler allows for effective cleaner production project management, delegation, and collaboration with colleagues and external organizations.

6. Reference profiles

The Profiler is also to be used in conjunction with "Reference Profiles". These enable direct comparisons to be made with other profiles with established thresholds and targets by allowing one profile to overlay another. For example, the chair manufacturing company might agree with the timber supplier a set of "Reference Profiles" which the supplier will work towards (**Figure** 7). Suppliers can use the "Reference" to measure their own progress and to present their results against. A "Reference Profile" will be supported by comprehensive "Notes" which provide the milestones and guidelines for the study. The power of "Reference Profiles" will be truly realized when recognized standards and methodologies are included in them. In-house company profiles can also be saved as "Reference Profiles", so that they can be shared between employees and work groups.

7. Information support

Cleaner production or any other environmental study is an information-intensive task. Even when the rules and method of a study are known, it is impossible to get away from the labour-intensive nature of gathering information and data to make the study of value. The information might come from many different sources and can vary from company to company. Intrinsic to the Profiler design is that it manages data from any source. The Profiler can work with WWW browsers to explore the databases and libraries that reside there (Figure 7). In time CD-ROM access and LCA database sources from third-party producers are to be integrated.

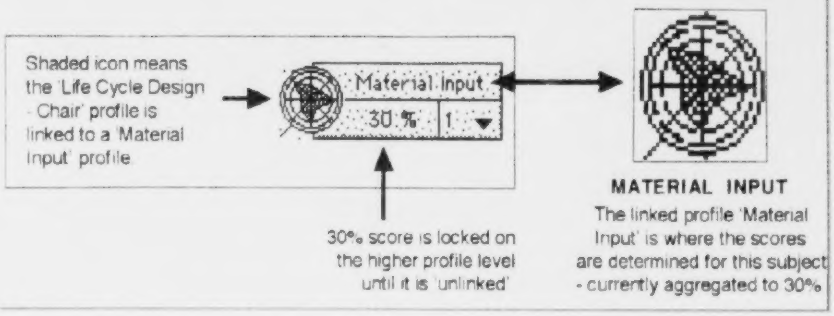
Sometimes a company may not have the time or resources to collect data, but does need to determine a policy direction. The Profiler can then act as a consensus-building tool. For example, round table discussion by senior management on cleaner production policy can be steered through selecting "topics" and prioritizing them by allocating a percentage score. In this case the discussion and the opinions raised that go towards the scores can be recorded in the "Notes" facility, and this is the information resource.

A Profiler example

To explain these seven key features in more detail, a simplified example follows. This is a fictitious case in which a chair manufacturing company is auditing the environmental impact of its products.

To undertake the study, the company has developed a life cycle design profile as the "primary profile". The primary profile shown relates the whole life cycle of a chair that the company manufactures. **Figure 3** shows the primary profile for the chair

Figure 6



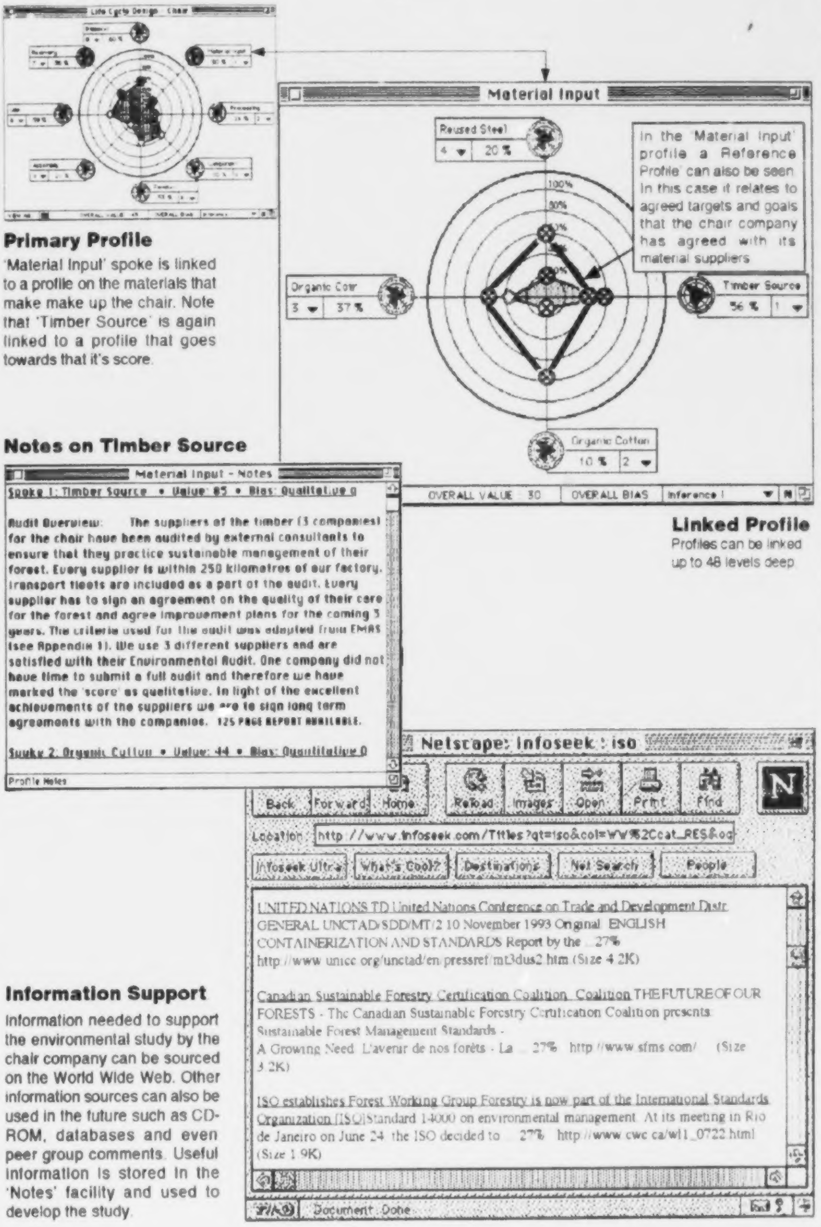
Shaded icon means the 'Life Cycle Design - Chair' profile is linked to a 'Material Input' profile

30% score is locked on the higher profile level until it is 'unlinked'

MATERIAL INPUT

The linked profile 'Material Input' is where the scores are determined for this subject - currently aggregated to 30%

Figure 7



Primary Profile

'Material Input' spoke is linked to a profile on the materials that make make up the chair. Note that 'Timber Source' is again linked to a profile that goes towards that it's score.

In the 'Material Input' profile a Reference Profile' can also be seen. In this case it relates to agreed targets and goals that the chair company has agreed with its material suppliers

Linked Profile

Profiles can be linked up to 48 levels deep

Notes on Timber Source

Spoke 1: Timber Source • Value: 85 • Bias: Qualitative 0

Audit Overview: The suppliers of the timber (3 companies) for the chair have been audited by external consultants to ensure that they practice sustainable management of their forest. Every supplier is within 250 kilometres of our factory. Transport fleets are included as a part of the audit. Every supplier has to sign an agreement on the quality of their care for the forest and agree improvement plans for the coming 3 years. The criteria used for the audit was adapted from EMAS (see Appendix 1). We use 3 different suppliers and are satisfied with their Environmental Audit. One company did not have time to submit a full audit and therefore we have marked the 'score' as qualitative. In light of the excellent achievements of the suppliers we are to sign long term agreements with the companies. 125 PAGE REPORT AVAILABLE.

Spoke 2: Organic Cotton • Value: 44 • Bias: Quantitative 0

Location: http //www.infoseek.com/Titles?qt=iso&col=WW%2Ccat_RES&oq

UNITED NATIONS TD United Nations Conference on Trade and Development Distr. GENERAL UNCTAD/SDD/MT/2 10 November 1993 Original ENGLISH CONTAINERIZATION AND STANDARDS Report by the ...27% http //www unicc org/unctad/en pressref/mt3dus2 htm (Size 4 2K)

Canadian Sustainable Forestry Certification Coalition Coalition THE FUTURE OF OUR FORESTS - The Canadian Sustainable Forestry Certification Coalition presents Sustainable Forest Management Standards - A Growing Need L'avenir de nos forêts - La ... 27% http //www sfms com/ (Size 3 2K)

ISO establishes Forest Working Group Forestry is now part of the International Standards Organization [ISO]Standard 14000 on environmental management. At its meeting in Rio de Janeiro on June 24 the ISO decided to ... 27% http //www cwc ca/wl1_0722 html (Size 1 9K)

Information Support

Information needed to support the environmental study by the chair company can be sourced on the World Wide Web. Other information sources can also be used in the future such as CD-ROM, databases and even peer group comments. Useful information is stored in the 'Notes' facility and used to develop the study.

and some of the key features of the Profiler software. Importantly, the criteria (topics to be audited) the company considers important for this exercise are shown in the "topic boxes".

This aspect of being able to simply and directly input criteria (topics) is an important part of the design.

Figure 3 shows "topics" that relate to the life cycle of a chair from material input (raw material) to final disposal. However, the software could be used to measure "stress in the workplace" or how much "energy" the photocopier in an office consumes. The user simply changes the "topic" box text to make the "Profiler" suitable for their project needs.

Topics are written into the "topic" box by the user (**Figure 4**).

This makes it context-sensitive and useful in hundreds of areas (in theory). Another feature to note is the quantitative, qualitative and inference marks that have been given to the life cycle design "topics" by the company along with the percentage scores (Figure 3). These can be changed at will and very simply – if users are not sure of the accuracy of their study, then for certain ones a qualitative mark should be given, especially as some things we try to measure are quite simply "subjective value judgments". Therefore, the Profiler allows the chair manufacturing company to show whether the result presented is factual and based upon science (quantitative), subjective and value-laden (qualitative), or a combination of both (inference) (**Figure 5**).

As already stated, the Profiler can "manage" as few as three or as many as 16 "topics" at the "primary" profile level. However, once linking is used, the Profiler can aggregate the sores of many thousands of "topics", as it can work down to 48 profile levels. All these "topics" can be individually measured between 0-100 per cent. **Figure 6** shows how the chair company's profile on "Life Cycle Design" is linked to a profile called "Material Input".

For an overview of the Profiler application in use, refer to **Figure 7**. It can be seen that the profile "Material Input" contains topics that are a subdivision of materials that make up the chair, e.g. recycled steel, timber source, organic cotton and coir. The "Notes" on the timber source are shown in order to describe why the scores and bias marks have been given. The chair company agrees that its timber suppliers have surpassed their agreed environmental targets and goals for the year, scoring 56 per cent. The fictitious "Reference" for them was 43 per cent. Meanwhile, the chair company is exploring the WWW to obtain better information on sustainable forestry. It may use this information in discussion with the suppliers, in order to identify other sustainable forestry opportunities.

In this way the software can be used to develop environmental impact profiles by each and every stakeholder in a production process for a product – from raw material source through to a product's end-of-life.

Future development

A future objective is to make the Profiler software available to companies, so that they may create profiles of their environmental activities (with supportive notes). These could be linked to "profiles" created by other partners in the production cycle with which a company is involved. The profiles can be secure or open to public access. Profile patterns created could be developed against, and compared with, internationally recognized standards by using their criteria as a "Reference".

To reach this objective, EDEN will concentrate on the development of enhanced features for the Profiler in the future. Ideas for accessing a wide range of data sources will be developed, and more powerful methods of working with data will be implemented. Nevertheless, controlling the data available is only part of the story. It is important that "Reference Profiles" are developed by users that meet cleaner production needs and help facilitate a move towards more sustainable forms of production and consumption. Could these profiles possibly be shared? "Reference Profiles" will contain valuable information and also provide the methodology, study boundaries and examples of best practice. This is an intellectual process based upon consensus building rather than software design. The author would like to hear from organizations interested in developing "Reference Profiles".

The Profiler is a fully working application in Apple Macintosh PPC version only. Cross platform development will follow. In 1997, a free version of the EDEN Eco Profiler will be made available on the World Wide Web for users worldwide (most likely on the UNEP-WG-SPD site). To be put on a mailing list for server details when it becomes available, please contact the author at ybenjamin@unep.frw.uva.nl (your E-mail would be appreciated).

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Design For Environment software

Mark S. Curtis, Partner, Design IV, 10 Hereford Road, Abergavenny, Gwent NP7 5PR, UK

The environment, and competitive advantage, are two all-important aspects of the 1990's. With the rapid implementation of environmental legislation, manufacturers are striving to turn their products "green" and reduce costs at the same time. Much to the relief of many manufacturers and designers, a new tool has been introduced to help ensure that innovative companies don't get caught out by new legislation – Boothroyd-Dewhurst-TNO's Design For Environment (DFE) software.

Throughout the past two years, development of DFE has been substantially reviewed by a worldwide consortium of industrial organizations to make it into a tool to be used by non-experts and experts alike. These organizations include Kodak, Xerox, AT& T of Scotland, Loctite Adhesives, Texas Instruments, Digital Equipment Corp., Sharp of Japan, Bell Northern Research (Nortel), GEP (AEG-Daimler Benz), Ascom and Océ.

DFE is an analysis tool that considers the disassembly sequence of products for end-of-life recovery as well as environmental impact. The resulting disassembly data reveals the associated cost-benefits for various options, such as material recycling, part remanufacture or reuse, and disposal through landfilling or incineration. Design teams can also pinpoint in the disassembly sequence where major economic AND ecological benefits stop and where further disassembly is of no benefit – either financially OR environmentally.

Alongside disassembly costs, DFE determines environmental impact with a value assessment metric developed by the TNO Institute of Industrial Technology in the Netherlands. The metric is called MET points (Materials-Energy-Toxicity). The Material assessment considers the product design's impact on the exhaustion of the earth's resources. The Energy section examines energy-related side-effects, like the greenhouse effect, acidification, eutrophication and smog. The Toxicity factor quantifies toxic effects in terms of human and eco-toxicity.

As questions in the disassembly and environmental sections of the software are answered, step-by-step change and improvement options are presented along with products' structure, costs and eco-effects. A graph display concisely summarizes the entire product analysis and allows tracking of disassembly costs with environmental impacts. Alternative designs or disassembly sequences can be compared on a single graph, allowing "what if" assessments.

Several countries, mainly in Europe, have put into effect "take-back" laws that pass the responsibility for the disposal of end-of-life products and packaging back to the manufacturer. Through using DFE, manufacturers will be able to understand the inherent value of a product's material and parts and will therefore be able to better plan for such "take-back" regulations.

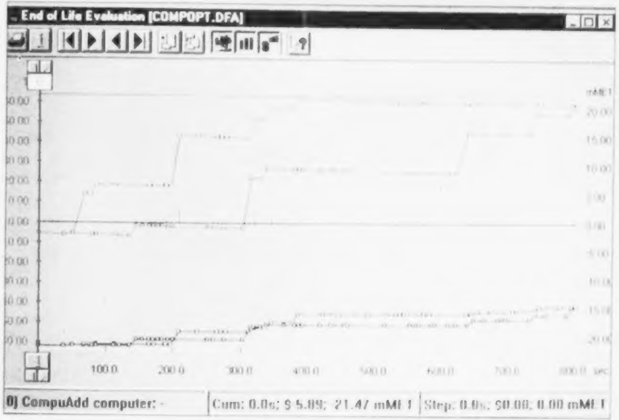
DFE will also assist organizations with their adoption of ISO14000, the first set of generic standards that aims to provide business management with a structure for managing environmental impact. DFE helps organizations quantify the environmental performance of a given product design and enables them to get a grip on such topics as "environmental performance evaluations", "labelling", "life cycle assessment", and "environmental aspects in product standards" – key areas that ISO14000 aims to cover. Like these standards, DFE will not replace environmental performance goals. Rather, DFE offers a structured procedure for looking at life cycle assessment AND disassembly at the end-of-life stage in order to assess the impact of a product on the environment. The ability to get valuable design-stage feedback helps companies assess their environmental position at the earliest stages of a design's evolution, and allows them to make improvements where necessary.

DFE guides and helps design teams understand and improve the degree of liability and eco-risk and guides them in improving the product design to minimize the eco-impact. Considerations include:

- ◆ pollution – understanding where pollutants are used or produced allows action to be taken to eliminate or reduce them;
- ◆ energy – DFE analysis will evaluate the energy consumed during production of the design and "score" the side-effect of using the corresponding resources;
- ◆ resources – material and process choices can be reconsidered AND changed to effect a more eco-friendly solution;
- ◆ profitability – DFE will highlight the limit of economic disassembly and allow "what-if" questions to be asked. Eco-impact and economic end-of-life recovery can be considered and their economic impacts optimized.
- ◆ "Greening" – there will be an increased market opportunity for "green" designs, and a rapidly shrinking market for environmentally unfriendly designs.

DFE aims to help organizations that are concerned with finding realistic trade-offs between the benefits and costs of environmentally sound designs. Engineering teams working alongside management can now address environmental design issues and costs within the context of total quality management programmes. Such an approach satisfies the requirements of ISO14000, which is expected to impact international trade from 1997 onwards.

For more information on DFE or DFMA, or to contact Boothroyd Dewhurst, Inc. or the TNO Institute, in the first instance please contactDesign IV, 10 Hereford Road, Abergavenny, Gwent NP7 5PR, UK. Tel: +44 1873 855700. Fax: +44 1873 855711. E-Mail: dfma@compuserve.com.



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A) *DFE software analyses and optimizes the disassembly sequence of products for end-of-life dismantling. Designers can pinpoint where in the disassembly sequence major economic and ecological benefits end and where further disassembly is of no advantage either financially or environmentally. The graph is a DFE analysis of a computer. The results depict the disassembly sequence and environmental impact of the existing design. The alternative design has been optimized for the best financial return on disassembly. The financial "payback" has now improved almost 100 per cent. Through recycling materials and reusing parts, the ecological index has also improved. BDI-TNO's DFE encourages designers to explore new materials and processes in order to find ways to make further gains.*

B) *BDI-TNO's Design For Environment (DFE) software is a Windows application designed to serve product engineers and concurrent engineering teams at the earliest stages of designing durable goods such as automobiles, computers, and industrial, military and consumer products.*

EPOQ (Evaluation Pour l'Optimisation de la Qualité écologique des produits)

ou comment optimiser la qualité écologique des produits Monoprix Vert par une approche créative et pragmatique

Mathilde Henry, responsable environnement d'O2 France, agence de design industriel et de conseil en environnement, 31, rue de la Folie Méricourt, 75011 Paris, France et Olivier Beyer, responsable qualité environnement développement produits, Monoprix, 3, rue Paul Cézanne, 75008 Paris, France

Abstract

The French retailer Monoprix has commissioned the French industrial design agency 02 France to assess the environmental quality of their "Monoprix Vert" range of products in order to endorse the label. The study has led to the development of a simplified assessment tool for the environmental optimization of products (EPOQ). The assessment process is explained and examples are given of product improvement within the "Monoprix Vert" range.

Résumé

Monoprix, distributeur français, a mené avec O2 France, l'évaluation de la qualité écologique de sa gamme Monoprix Vert en vue d'authentifier sa marque. Cette étude a permis de développer un outil d'évaluation simplifiée : EPOQ (Evaluation pour l'Optimisation de la Qualité écologique des produits). L'article explique le processus d'évaluation et présente des exemples d'améliorations apportées sur les produits Monoprix Vert.

Resumen

Monoprix, distribuidor francés, ha llevado a cabo con O2 France, la evaluación de la calidad ecológica de su gama Monoprix Vert *con miras a autenticar su marca. Dicho estudio permitió desarrollar una herramienta de evaluación simplificada : EPOQ (Evaluación para la Optimización de la Calidad ecológica de los productos). El articulo explica el proceso de evaluación y presenta ejemplos de mejora brindados a los productos* Monoprix Vert.

Génèse

Né du besoin d'évaluer la qualité écologique des produits, le principe d'EPOQ (Evaluation Pour l'Optimisation de la Qualité écologique des produits) a été posé par Jean-Paul Ventère dans son livre *La qualité écologique des produits* (éditions Afnor et Sang de la Terre, janvier 1995). Celui-ci présente les bases d'une méthodologie qualitative.

En octobre 1995, Monoprix, distributeur français dans les centres-villes, confie à O2 France la mission d'évaluer onze produits de sa gamme Monoprix Vert, première gamme de produits verts lancée sur le marché français en 1989. En août 1996, l'Ademe (Agence de l'environnement et de la maîtrise de l'énergie) cofinance la deuxième tranche d'étude pour évaluer le reste de la gamme Monoprix Vert. L'Ademe s'intéresse à cet outil en tant qu'approche d'évaluation simplifiée.

Monoprix a la volonté d'authentifier la qualité de son label auto-proclamé par une expertise extérieure. C'est également pour cette raison que ses produits sont écolabellisés lorsque des réglements techniques existent. Ainsi les sacs poubelle Monoprix Vert (**Figure 1**) furent les premiers produits de marque distributrice à recevoir l'écolabel NF Environnement. Les essuie-tout et papier toilette (**Figure 2**) en rouleaux et paquets Monoprix Vert furent également les premiers produits de marque distributrice du marché français à recevoir l'écolabel européen. Ils sont encore les seuls.

EPOQ, un outil d'aide à la décision pour l'entreprise

Le premier jet d'étude comparait chaque produit Monoprix Vert au produit phare sur le marché national et à son équivalent des sous marques Monoprix Sipratic et Beaumont. Cette triple comparaison a fait apparaitre la nécessité de positionner la marque Monoprix Vert sur sa qualité et, par conséquent, de garantir la qualité fonctionnelle des produits afin de limiter l'association qu'effectue le consommateur entre produit vert et faible efficacité. Pour contrer cela, la qualité environnementale d'un produit vert doit ressortir comme une de ses performances, mais pas comme l'unique. Enfin, une communication adaptée permet de hisser la gamme Monoprix Vert vers le haut tout en restant à des prix compétitifs.

EPOQ en pratique

La gamme Monoprix Vert est constituée d'une trentaine de produits génériques appartenant aux rayons droguerie, hygiène, cuisine et papeterie. Le processus d'évaluation est simple, il dure six mois : quatre pour définir une nouvelle catégorie de produits et deux pour évaluer un produit dont la catégorie est déjà définie. L'adaptation de l'outil au cahier des charges de Monoprix a coûté moins de 100 000 FF ; le coût par catégorie de produit oscille entre 50 000 et 80 000 FF, et le coût par produit entre 20 000 et 50 000 FF. Le processus aboutit à des suggestions d'améliorations soumises à l'acheteur de Monoprix qui suit leur mise en oeuvre par le fournisseur.

O2 France, avec le concours d'Alec de Richemont de l'association Les Amis de la Terre, a développé les modalités pratiques d'application d'EPOQ en fixant un cahier des charges avec la centrale d'achats de Monoprix. O2 France définit un produit de qualité écologique par ses aptitudes à l'emploi et à la vente et par son faible impact sur l'environnement, en comparaison avec les performances du produit concurrent. Ces aptitudes se traduisent par trois "valeurs": la valeur d'usage, la valeur commerciale et la valeur environnementale. Puis les critères d'évaluation sont affinés et une procédure est mise en place.

La procédure débute par l'envoi d'un questionnaire et d'un engagement de confidentialité signé par Monoprix et O2 France au fournisseur Monoprix Vert. Le questionnaire désigne le produit concurrent de Monoprix Vert et demande au fournisseur de positionner ce produit et d'énoncer ses avantages comparatifs, la composition et les constituants du produit et de l'emballage. Celui-ci met ensuite à la disposition des évaluateurs des échantillons du produit Monoprix Vert et de son concurrent.

Les valeurs d'usage de l'emballage et du produit

Le groupe d'évaluation rassemble les différentes compétences d'O2 France – designers, responsables marketing et spécialistes en environnement – complétées par Alec de Richemont des Amis de la Terre, invité en tant qu'expert.

Ce groupe procède à l'analyse comparative de la valeur d'usage des deux emballages. La valeur d'usage s'appuie sur le principe qu'un produit écologique doit avoir une performance au moins équivalente à celle du produit comparé. Elle consiste à évaluer la clarté de l'information et à définir les critères fonctionnels des deux emballages. Le groupe leur donne alors une des cinq appréciations suivantes : très favorable, favorable, médian, défavorable, très défavorable. Celles-ci sont postérieurement traduites en notes pour en simplifier la lecture. Elles pourraient également apparaître sous forme de profils ou de couleurs.

Le groupe agit de même pour la valeur d'usage du produit en définissant et en appréciant ses critères d'aptitude à la fonction (efficacité) et à l'usage (facilité d'emploi par l'utilisateur). La pertinence des appréciations s'appuie sur les tests de performance comparatifs communiqués par les fournisseurs et réalisés par des laboratoires indépendants.

L'approche créative des évaluateurs se traduit par des suggestions pragmatiques pour l'amélioration de l'emballage et du produit, qui sont hiérarchisées par la suite.

La valeur commerciale du couple produit-emballage

La valeur commerciale n'était pas initialement envisagée. Elle est née du désir des évaluateurs d'apprécier ce qui fonde l'existence d'un écoproduit : son succès commercial. En effet, l'avantage pour l'environnement d'un produit écologique est nul si celui-ci n'est pas vendu. Deux critères ont donc été définis : l'impact visuel qui déclenche l'acte d'achat et le plaisir d'usage qui fidélise le consommateur. Ils sont appréciés suivant le même processus que pour la valeur d'usage. Cette évaluation comparative est tout à fait subjective et c'est là son intérêt. La fécondité de la méthode est étroitement liée à ce parti pris subjectif et à la pluridisciplinarité du groupe d'évaluateurs. Par ailleurs, cette subjectivité est limitée du fait que les appréciations ne sont jamais absolues, mais toujours relatives au produit comparé.

L'analyse de la valeur commerciale peut donner lieu à deux stratégies marketing pour un distributeur : reprendre les axes opportuns de communication du leader ou se démarquer de façon tranchée.

Les valeurs environnementales de l'emballage et du produit

Un emballage ou un produit est comparé à un système où circulent des flux intrants et extrants. Cette approche systémique (**Figure 3**) a l'avantage de prendre en compte toutes les étapes du cycle de vie de l'emballage ou du produit. Elle se traduit par deux types de critères. En amont, les ressources et l'énergie consommées par la production du produit et des matériaux qui le composent, et, en aval, les pollutions et déchets générés par l'élimination du produit ou de l'emballage. Pour apprécier ces critères, des données quantitatives pour chaque type de matériaux ou de composants sont sélectionnées selon leur pertinence. En d'autres termes, ces données représentent l'impact environnemental jugé le plus important par les experts en environnement à l'étape du cycle de vie considérée. Ces données sont issues de banques de données publiques et leur pertinence pour la France est validée si elles sont d'origine étrangère. La comparaison s'effectue entre des produits assurant la même fonction principale. Dans le cas où les produits comparés sont conditionnés sous des volumes différents ou présentant des différences d'efficacité par unité de poids ou de volume, les données prises en compte pour l'évaluation devront être rapportées à une "unité fonctionnelle" : soit la quantité nécessaire pour obtenir un effet identique ou très proche.

Figure 1
Sacs-poubelle Monoprix Vert ayant reçu l'écolabel NF environnement

Volume des emballages et transport

Les critères ci-dessus ne tiennent pas compte de l'aspect transport. Alec de Richemont a souligné l'intérêt du coefficient volumique de l'emballage (CVE) défini comme le rapport du volume occupé par l'emballage primaire au volume effectivement contenu (**Figure 4**).

L'emballage peut être considéré comme un critère déterminant pour améliorer l'efficacité du transport. L'impact sur le transport peut être évalué par rapport à un critère spécifique : l'optimisation du volume de l'emballage. Celle-ci peut être appréciée grâce à deux outils : le CVE et le volume unitaire de regroupement (VUR). Le VUR est le volume occupé par une unité de produit dans l'emballage de regroupement dans lequel il est livré (**Figure 5**).

Le CVE idéal est égal à 1, c'est-à-dire à un parallélépipède plein. Cette solution optimale est rarement envisageable pour des raisons de marketing, qui nécessite des formes différenciatrices, ou pour des raisons techniques de remplissage, comme pour les produits pulvérulents ou mousseux. Ce coefficient a le mérite de mesurer un vide, qu'il est toujours possible de réduire en améliorant le remplissage ou en modifiant les formes extérieures de l'emballage sans fonction.

Le VUR a été mis au point pour les produits souples ou compressibles, comme les rouleaux d'essuie-tout. Il doit être le plus faible possible. L'évaluation du VUR permet d'ajuster le volume des emballages de regroupement et ainsi de diminuer la consommation de matériaux d'emballage.

L'incidence du volume de l'emballage primaire (CVE) ou secondaire (VUR) se reporte sur toute la logistique du transport des produits.

Figure 2
Essuie-tout et papier toilette Monoprix Vert ayant reçu l'écolabel européen

EPOQ, une approche qualitative

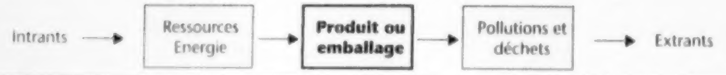
De même que la qualité fonctionnelle du produit s'appuie sur des tests quantitatifs, la qualité environnementale du produit ou de l'emballage est basée sur des données quantitatives. L'approche d'EPOQ passe donc par une interprétation qualitative d'éléments quantitatifs. Cette approche créative fondée sur l'interprétation peut conduire à des améliorations concrètes. En revanche, EPOQ fait l'économie de l'étape d'inventaire des flux quantitatifs en se référant à l'existant. C'est pourquoi EPOQ est un outil d'évaluation simplifié.

EPOQ, des résultats concrets

Une fois le produit et son emballage évalués, il est possible de corriger leurs points faibles et de mettre en valeur leurs points forts. Si le produit ne peut pas évoluer pour satisfaire les critères d'EPOQ, Monoprix prend la décision de le sortir de la gamme Monoprix Vert. Ce fut le cas de quelques produits ayant connu une avance environnementale lors de leur lancement, mais qui furent ensuite rattrappés par la concurrence.

Avant de se lancer dans cette politique d'évaluation, Monoprix avait déjà retiré de sa gamme les

Figure 3
L'approche systémique du produit ou de l'emballage



couches-culottes pour bébé car celles-ci avaient une valeur d'usage deux fois plus faible que celle des leaders. Cette faible efficacité se traduisait par une consommation double qui réduisait a néant tout gain environnemental.

Si l'évaluation aboutit à des suggestions d'amélioration qui sont économiquement et techniquement réalisables, Monoprix travaille alors avec ses fournisseurs pour améliorer les caractéristiques fonctionnelles et environnementales du produit. Voici quelques exemples concrets d'amélioration des produits:

- La colle des revers gommés des enveloppes autocollantes Monoprix Vert se conservait moins bien que celle des enveloppes auto-adhésives, protégée par une bande plastique. Afin de préserver l'avantage environnemental de ce type d'enveloppe (pas de bande plastique) et l'avantage fonctionnel qui évite le geste de décoller et de jeter la bande, on a amélioré l'emballage. Initialement constitué d'un film de cellophane qu'il fallait déchirer pour ouvrir le paquet d'enveloppes, on a rajouté une languette qui permet d'ouvrir proprement le paquet et de le refermer ensuite.
- La blancheur des papiers d'écriture a été revue à la hausse, les techniques de blanchiment (à l'oxygène...) du papier recyclé ayant visiblement progressé depuis le lancement de ces produits.
- La plupart des clients de Monoprix se déplaçant à pied ou en transport en commun, on a jugé que le poids et le volume des emballages constituent un critère d'achat important. Pour les produits détergents, la solution consiste à reformuler le produit en le concentrant davantage afin de diminuer l'impact environnemental de l'emballage et du transport et d'améliorer l'aspect pratique du transport et du stockage pour le consommateur.

De nombreuses autres améliorations des produits Monoprix sont en cours et vont bientôt être mises sur le marché.

EPOQ, un outil de communication produit

Pour accompagner ces changements et valoriser la qualité de la gamme, Monoprix a souhaité faire figurer sur l'emballage ses principales caractéristiques fonctionnelles et environnementales en en hiérarchisant les avantages. La gamme, lancée en 1989, utilisait un langage émotionnel avec des partis pris techniques subjectifs, à l'image des arguments négatifs : "sans CFC". Monoprix a fait le choix d'une communication conforme au code du Bureau de la Vérification de la Publicité, c'est-à-dire une information claire et objective où les arguments sont étayés par des données aisément vérifiables. Les nouveaux textes sur les emballages des produits Monoprix Vert mettront en avant leurs qualités fonctionnelles et environnementales en renonçant au discours du "non polluant". Ainsi Monoprix fait le pari qu'une information qui sensibilise le consommateur sera un élément de fidélisation et de préférence.

L'évaluation, un outil de formation et de sensibilisation internes

Monoprix a fait réaliser le premier jet d'étude en externe, en le confiant à O2 France et à Alec de Richemont. Par la suite, Monoprix, accompagné par O2 France, a évalué ses produits en interne. Cette évaluation a été validée par O2 France et Alec de Richemont.

Le groupe d'évaluation de Monoprix était composé d'un responsable environnement, d'un responsable conditionnement et des acheteurs concernés, qui sont responsables du marketing de leurs produits. Ce fut l'occasion de vérifier qu'EPOQ était un outil appropriable par des fonctions sans lien avec des compétences environnementales. Cette expérience a aussi confirmé qu'EPOQ peut être un outil de formation puisque les acheteurs de Monoprix sauront désormais utiliser les critères des trois valeurs définies pour sélectionner un nouveau produit Monoprix Vert. Pour garder son impartialité, toute évaluation interne a néanmoins besoin d'une validation extérieure, notamment lorsqu'elle a un objectif de communication.

EPOQ, une approche produit

Les sites industriels peuvent être considérés comme des pollueurs sédentaires et les produits comme des pollueurs nomades. La réglementation motive la stratégie environnementale des industriels, qui agit comme un saumon remontant le courant. Les industriels se sont d'abord concentrés sur l'aval de la production : les déchets. Ils remontent maintenant jusqu'au procédé en maîtrisant les effluents. Reste à revoir la conception des produits. Cet ultime et premier objectif vise à parier davantage sur la matière grise que sur la matière. En effet, la reconception d'un produit peut remettre en cause son procédé de fabrication. Pour O2 France, le déchet le plus facile à traiter est celui qui n'est pas produit. C'est pourquoi O2 France travaille en amont dès la conception du produit avec une approche cycle de vie, afin de minimiser les déperditions de matière et d'énergie sur tout le cycle de vie du produit et d'améliorer ses performances économiques. Grâce à EPOQ, O2 France peut également travailler sur des produits existants pour répondre aux mêmes objectifs.

◆

Figure 4
Coefficient Volumique d'un Emballage
CVE

Ce coefficient est déterminé par le rapport :

$$\frac{\text{Volume occupé par l'emballage (VE)}}{\text{Volume du contenu de l'emballage (VC)}}$$

VE est le volume du parallélépipède dans lequel s'inscrit l'emballage
VC est le volume du contenu emballé

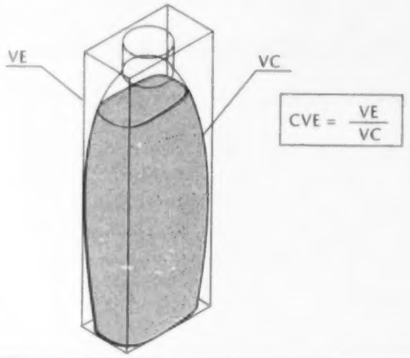
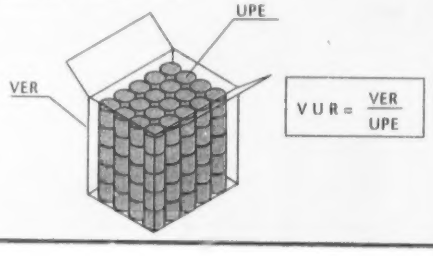


Figure 5
Volume unitaire de regroupement
VUR

Ce volume est déterminé par le rapport :

$$\frac{\text{Volume de l'emballage de regroupement (VER)}}{\text{Unité de produit contenues par l'emballage de regroupement (UPE)}}$$

VER est le volume du parallélépipède de l'emballage de regroupement
UPE est le nombre de produits emballés



Gamme de mobilier pour le catalogue 3 Suisses printemps-été 1995 : une conception de O2 France avec une approche en cycle de vie

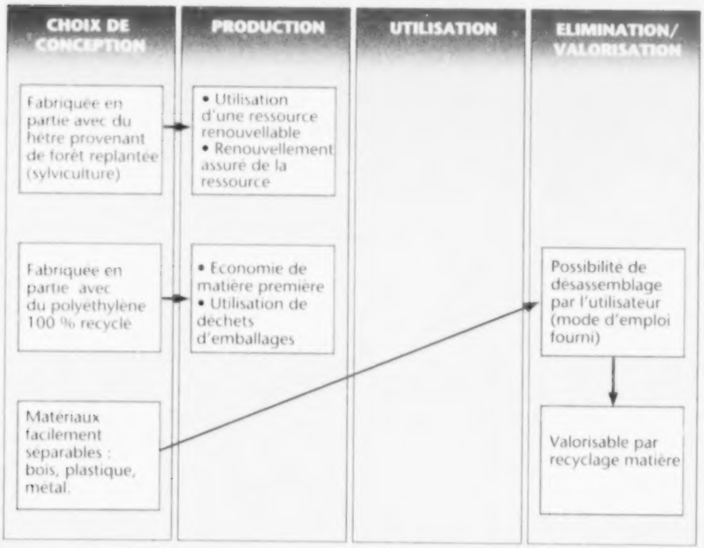
Mathilde Henry, responsable environnement d'O2 France, agence de design industriel et de conseil en environnement,
31, rue de la Folie Méricourt 75011 Paris, France

En 1993, le chargé de mission environnement des 3 Suisses, distributeur français par correspondance, a contacté 02 France pour imaginer une gamme de meubles de qualité environnementale. Il demande à 02 France d'intégrer au cahier des charges le critère de coût de fabrication afin de respecter les prix de vente en usage pour du mobilier 3 Suisses. Cette gamme a été conçue par Thierry Kazazian, directeur d'02 France et Matthew Sindal, designer associé.

02 France utilise l'approche du cycle de vie pour concevoir la gamme de meubles 3 Suisses. L'idéal recherché est d'éviter toute déperdition de matière ou d'énergie de la conception à l'élimination du produit. Cette démarche de conception consiste à prendre en compte toutes les étapes du cycle de vie du produit : matières premières, production, utilisation et valorisation, ainsi que celui de l'emballage afin de réduire ses impacts sur le transport.

Concrètement, les designers dessinent un scénario pour chaque choix de conception et envisagent les conséquences sur l'environnement à chaque étape du cycle considérée (**Figure 1**). La synthèse des différents scénarios permet de hiérarchiser les choix selon un critère d'impact minimum sur l'environnement. Les choix de conception retenus figurent dans le tableau illustrant le cycle de vie de la chaise sous forme linéaire. Les designers ont voulu jouer sur l'association d'un matériau naturel, le bois pour les montants et d'un matériau artificiel, le plastique recyclé pour l'assise. Ainsi, l'aspect de surface du plastique recyclé a été travaillé afin de lui donner un aspect et un toucher marbrés proches de celui du bois afin de donner une plus-value sensorielle à un matériau de synthèse. Ce travail de mise au point est intéressant car il permet de définir de nouveaux matériaux, bien que recyclés. Il a aussi permis des essais de coloration, non repris dans la gamme. De plus, le projet développé pour les 3 Suisses démontre que le plastique recyclé peut être utilisé pour des objets courants, tout en respectant l'échelle des prix pratiques par la vente par correspondance. La forme de la pièce plastique a été dessinée afin de diminuer les coûts de fabrication et de réduire le nombre d'opérations industrielles. En effet, un seul moule est nécessaire pour toute la gamme (chaise, tables et bibliothèques), le plastique est ensuite découpé à la dimension de chaque meuble.

Figure 1


CHOIX DE CONCEPTION
PRODUCTION
UTILISATION
ELIMINATION/ VALORISATION
Fabriquée en partie avec du hêtre provenant de forêt replantée (sylviculture)
• Utilisation d'une ressource renouvellable
• Renouvellement assuré de la ressource
Fabriquée en partie avec du polyéthylène 100 % recyclé
• Economie de matière première
• Utilisation de déchets d'emballages
Possibilité de désassemblage par l'utilisateur (mode d'emploi fourni)
Matériaux facilement séparables : bois, plastique, métal.
Valorisable par recyclage matière

Le vernis protégeant le bois a une base acqueuse pour limiter les rejets de solvants. L'assise de la chaise est aisément réversible afin de doubler sa durée de vie. Sous l'assise et les plateaux de table se trouve un espace de rangement et les panneaux des bibliothèques se ferment et à droite ou à gauche ce qui introduit des fonctions supplémentaires.

Les filières de recyclage des produits automobiles chez Renault

Renault, Direction de la Communication, 34 Quai du Point-du-Jour, 92109 Boulogne Billancourt Cedex, France

Renault est conscient que son avenir dépend de plus en plus de sa capacité à limiter les nuisances créées par l'automobile. L'entreprise prend en compte le recyclage à tous les stades de la vie d'un véhicule, de sa conception à sa destruction, en passant par son usage en clientèle.

Renault organise des filières de recyclage des produits automobiles usagés : batteries, pare-chocs en polypropylène, pots d'échappements catalytiques, huiles et solvants.

La récupération des produits automobiles usagés se fait au moyen de conteneurs mis en place dans les ateliers des points de vente et de service de la marque. Une fois la collecte réalisée, chaque famille de produits est livrée à une entreprise de recyclage agréée par Renault pour son savoir-faire dans la production de matière recyclée.

Metaleurop valorise les batteries, C.2.P. (filiale de Metaleurop) se charge des boucliers, la société Engelhard recycle les pots catalytiques et le groupe SARP Industrie retraite les solvants.

Ces matières recyclées fournissent à l'industrie de véritables substituts de matière première pour fabriquer de nouveaux produits. Elles contribuent ainsi à économiser des ressources naturelles en créant une nouvelle source de matières premières pour l'industrie.

Initialisée en Allemagne et sur la région de Tours en juin 1991, ce schéma de récupération s'est déployé progressivement sur l'ensemble de l'Europe. Renault a ainsi mis en place la première filière de recyclage automobile à une échelle européenne. Elle implique la quasi-totalité des concessions et des succursales de son réseau commercial européen.

Cette démarche de récupération des produits usagés s'étend aux particuliers avec la mise en place de points de collecte libre service « Escale verte ». Les particuliers peuvent y déposer en libre-service dans des conteneurs spécifiques six types de produits usagés : batteries, huile de vidange, bidons d'huile, filtres à huile, boucliers et pots catalytiques. Leur valorisation suit la même filière que les déchets générés par les ateliers du réseau commercial de Renault.

Outre les produits dérivés de l'automobile, Renault s'implique également dans le traitement des véhicules en fin de vie.

En France, 75 % du poids d'une automobile sont déjà recyclés. Reste à traiter les 25 % de matières non métalliques mises en décharge. Ce résidu de broyage automobile (RBA) est essentiellement constitué de plastiques, caoutchouc, verre, mousse, textiles, huiles et fluides divers.

Recyclage, Athis-Mons, France

Renault met en place avec les démolisseurs et les broyeurs, des chaînes de dépollution et de désassemblage d'un maximum d'éléments valorisables avant le broyage de la carcasse. Ces opérations de dépollution et de démontage permettront de réduire le RBA ultime non valorisable de 25 à 15 %. A terme, le tout contribuerait à obtenir un RBA ultime de l'ordre de 5 %.

Renault a mis en place pour la première fois ce processus industriel en collaboration avec la Compagnie Française des ferrailles (C.F.F.) sur le site d'Athis-mons. Vingt schémas de traitement régionaux du même type seront nécessaires pour recycler les 3 000 véhicules Renault qui arrivent en fin de vie chaque jour en France. Les véhicules seront traités de manière analogue en Europe, en partenariat avec d'autres constructeurs.

Renault intègre des matières recyclées et recyclables dans ses véhicules

La filière de recyclage des batteries

Renault introduit une part croissante de matériaux recyclés dans ses véhicules. Un certain nombre de modèles de la gamme Renault sont aujourd'hui équipés de passages de roue fabriqués à base de polypropylène de seconde génération. Certains véhicules intègrent également des caissons de pare-chocs, des skis sous moteurs ou des boucliers plastiques recyclés.

Renault et les opérateurs de la filière de recyclage s'emploient à obtenir une matière secondaire qui dispose des mêmes qualités en terme de contraintes générales des cahiers des charges et plus particulièrement de sécurité, et de prix de revient que la matière première.

Les matières de seconde génération permettent dans le meilleur des cas de réaliser la même pièce. A défaut, elles sont utilisées dans des pièces automobiles moins exigeantes en terme d'aspect ou de résistance.

Si elles ne présentent pas encore les qualités mécaniques ou esthétiques exigées dans l'industrie automobile, elles trouvent des applications dans d'autres biens de consommation (conditionnement pour l'horticulture, roulettes de caddies etc.).

Les matières qui n'ont pas encore trouvé de solutions de recyclage suivent la voie de la valorisation énergétique. C'est généralement le cas des fluides, des mousses de sièges, des joints et des pneus.

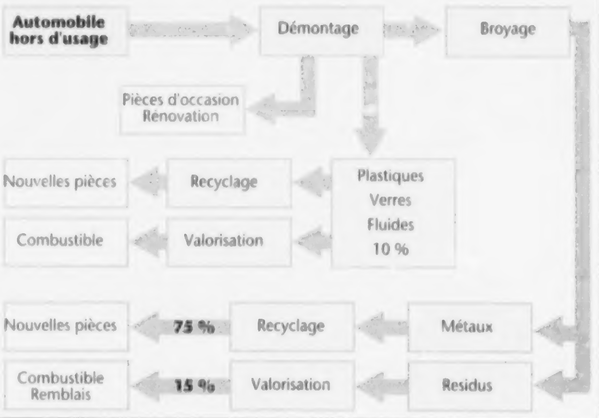
Renault intègre de plus en plus le paramètre recyclage dans le processus de conception et de fabrication de ses produits. Ainsi l'entreprise modifie progressivement le dessin et la composition des pièces, le choix des matériaux, les techniques d'assemblage, pour améliorer le recyclage de ses véhicules.

L'emploi de pièces monomatériaux, le marquage des pièces plastique, la réduction du nombre de familles de plastiques visent à faciliter le démontage et le tri des pièces à recycler.

Enfin, Renault a décidé d'associer l'ensemble de ses fournisseurs pour incorporer davantage de matières recyclables et recyclées dans ses véhicules.

Cela implique un travail commun et des responsabilités partagées entre tous les acteurs du cycle de vie de l'automobile pour créer des circuits de valorisation techniquement et économiquement viables.

Schéma théorique de traitement d'un véhicule hors d'usage



The Evergreen carpet lease programme from Interface, Inc.

Ray C. Anderson, Chairman and Chief Executive Officer, Interface, Inc., 2859 Paces Ferry Road, Suite 2000, Atlanta, Georgia, 30339 USA

Abstract

This article explains the environmental benefits of the Evergreen commercial carpet leasing programme and how the programme functions. Two immediate benefits have been the diversion of carpet products from disposal to landfill and increased recycling opportunities. The company is committed to strive towards a totally sustainable closed-loop operation.

Résumé

Cet article explique les avantages en termes d'environnement et le principe de fonctionnement du contrat de fourniture et d'entretien des moquettes Evergreen (moquettes proposées sous forme de dalles qui sont remplacées et recyclées lorsqu'elles sont usagées). Il présente deux avantages immédiats : il réduit les quantités de moquette jetées dans les décharges et offre de nombreuses possibilités de recyclage. L'objectif de la société est de parvenir à une activité en circuit fermé, totalement viable sur le plan écologique.

Resumen

Este artículo explica los beneficios medioambientales del programa de alquiler de la alfombra comercial Evergreen y del modo de funcionamiento del programa. Los dos beneficios inmediatos obtenidos fueron la diversificación de productos de alfombrado, de desechos a rellenado de terrenos, y las mayores posibilidades de reciclado. La compañía está comprometida en lograr una operación totalmente en ciclo cerrado sostenible.

Introduction

Warmth, texture, acoustic effects, comfort underfoot, and cleanliness. These are some of the benefits or services, and aesthetic values, carpet provides in a commercial office environment. Functionality, aesthetics and flexibility are the practical features specified by every customer. As the world's largest manufacturer of commercial carpet and other textile finishes that make up the modern office environment, Interface, Inc. has shifted its focus from a product to a service orientation. With this change comes a wealth of opportunities to increase the value provided to its customers, and to retain more responsibility for the reclamation and recycling of its products once their useful lives have been exhausted.

Twenty-five years ago, Interface was the first manufacturer to introduce the flexibility and functionality of free-lay carpet tile to the American market. It was 1973, the commercial interiors market was strong, and technology was beginning to proliferate in the workplace. Originally, carpet tile was the key to meeting the floor covering needs of the increasingly "modular" workplace. Today, Interface manufactures a host of complementary products that augment the functionality of carpet tiles – raised access flooring, special equipment that lifts modular furniture for easier flooring installation, chemicals that make the workplace healthier, and the fabrics that are part of office furniture and walls. As Interface has moved towards sustainable and restorative manufacturing processes, it has pioneered an industry first: offering commercial carpet tile as a "product of service" through an Evergreen Lease Programme.

The Evergreen Lease programme

Introduced to the United States by Paul Hawken, William McDonough, and other environmental consultants, the concept of "products of service" is embodied in the Evergreen Lease. As an alternative to the conventional process of purchasing flooring, the end customers have the option to lease the services the carpet tile provides – functionality, flexibility, and aesthetics – without taking ownership or liability for the disposition of the product at the end of it's useful life.

In the Evergreen Lease, Interface, as the manufacturer, not only makes the carpet with state-of-the-art recycled content, but also takes responsibility for installing the carpet, maintaining it, and – because it is free-lay carpet tiles – selectively replacing worn or damaged areas, one 18-inch square at a time. This way, a sort of rolling, progressive, continuous facelift is implemented through periodic replacement of worn, high-traffic area modules. The carpet tiles that come up are reclaimed and recycled. Interface continues to own the carpet. Title for the carpet tiles never passes to the user; it stays with Interface, the manufacturer, as does the ultimate liability for used-up, exhausted carpet tiles. The user pays by the month for the services and benefits the carpet provides, and avoids the landfill disposal liability altogether.

Under the terms of the Evergreen Lease, the economic advantage of carpet tiles for the user is unconditionally and contractually assured. However, the economic viability of the Evergreen Lease for Interface, and its ultimate value to the Earth, depends on Interface's ability to close the loop, i.e. to recycle used face fiber into new face fiber and used carpet tile backing into new carpet tile backing. While the company has yet to learn to do either economically and energy-efficiently, it continues to explore systems and processes that will eventually create a closed-loop, sustainable industry standard resulting in full "cradle to cradle" responsibility for the entire cycle: manufacture, installation, maintenance and recycling of all of the company's products.

The economics of the Evergreen Lease

The Evergreen Lease is designed to be perpetual in nature. However, it is often broken into building blocks of three seven-year cycles, or leases.

The First Cycle: Design and product selection are established, with long-term objectives. Specifiers are encouraged to go through a process that helps match product performance with anticipated traffic and maintenance demands. Once the traffic flow is identified, a listing of appropriate products is made. After selection, products are subjected to wear simulations on an appearance retention tester that forecasts the appearance of the carpet after five, ten and 15 years. The final step in the first cycle is installation, with design allowances for periodic change-outs in "track off" areas – points on the carpet that receive the most wear, such as exterior access, lobby, and transition from a hard surface.

The Second Cycle: A renewal lease is engaged for areas needing renovation, such as the 20 per cent high-traffic aisleways, which generally receive up to 80 per cent of the wear, and for additional, periodic change-outs of the track off areas.

The Third Cycle: A combination of new and existing product may be reconfigured to rejuvenate the facility. The modular, free-lay nature of our carpet tile lends itself to the flexibility of design change as needed, thereby prolonging the useful life of the carpet and utilizing less natural resource-based material and energy over the life cycle.

The benefits of the Evergreen Lease

There are both immediate and long-term benefits to the programme. A commitment to divert carpet products from already overburdened landfill systems is an immediate benefit. In 1996 Interface pioneered the production of carpet products with less nylon face fiber, with no compromise of quality or design. In some cases, wearability has actually improved. This reduction in nylon use is significant. At one plant in LaGrange, Georgia, nylon fiber use was reduced by one million pounds per year, and carpet performance improved from 6.5 to 7.8 on a ten-point scale. Although the ability to recycle all the carpet waste internally hasn't been totally perfected, Interface has been successful in providing carpet waste to other industries for use as a raw material in their products, thus reducing the overall need for new petroleum-based products.

The potential long-term cost savings to Interface customers are dependent on their participation in all three cycles of the leasing system, as well as on interest rate variables. There are several factors that make the Evergreen Lease an attractive option. Customers engage in a one-time, one-source service partner agreement with the manufacturer, reducing the number of vendors in their purchasing system. Additionally, they avoid a large up-front capital expenditure and opt instead for a monthly service fee. Finally, the three-cycle leasing programme has a built-in maintenance feature that assures a facility manager that the carpet will always look as good as it does when it is installed. It is in Interface's direct financial interest to see that it does. Even longer term, as closed loop recycling produces a net resource gain, Interface will share the financial benefits of such gain with its customer/partner.

Case study: Southern California Gas Company Energy Resource Center

The Evergreen Lease business began in 1994 at the urging of an environmental consultant, John Picard, and the Southern California Gas Company. A landmark building, the Energy Resource Center (ERC), was being constructed by the gas company with 60 per cent recycled building materials, high energy efficiency, and advanced indoor air quality controls. Interface filled a need the company identified for a perpetual lease on flooring by installing carpet tiles under the Evergreen Lease Programme outlined above. The ERC, which is still in the first cycle of this leasing programme, reports no concerns or problems with appearance, functionality or wearability.

Perfecting the Evergreen Lease Programme

The Evergreen Lease Programme is not without its obstacles. The primary obstacle in the acceptance of this programme is rooted in the economic justification of the programme within the current market structure. Customers still must be educated about environmental responsibility, as well as the liabilities of product ownership. Shifting from a short-term, disposable mentality to a long-term, products-of-service mentality will take some time.

Additional barriers come in the form of technology and energy. Currently, the technology to completely break down carpet pile and "purify" the fibers for reuse has not been perfected. The backing system can be reused, but finding the means to process it in mass quantities for standard production is still an issue.

The low cost of energy also impedes the success of this programme, because customers see no real financial incentive to reduce energy consumption. Within the next two years, Interface believes it will manufacture closed-loop, recyclable products that require far less energy and material and thus produce a net resource gain. Until something – perhaps higher energy or petrochemical costs – makes these products more financially compelling, Interface will continue to face these marketing difficulties.

Finally, finding progressive financial partners who are willing to embrace this "perpetual lease" theory has been difficult. Interface's current thinking is that a standard seven-year limit for a lease of this nature is too short. The "value" for the carpet product's service is paid for in the first cycle of the lease, but the useful product "life" does not end during this cycle. The possibility of extending the lease terms to ten years is another option being explored, with monthly payments based on ten years and an option to pay off or refinance the lease at the end of year seven. A way must be also devised to factor in a salvage value for used-up, exhausted carpet. That value is presently indeterminate.

Partners in the process

Interface markets carpet tiles internationally under the brands Bentley Mills, Interface Flooring Systems, and Heuga. Additionally, Interface Architectural Resources and Re:Source Americas are networked with these carpet brands to provide further options such as raised access flooring and furniture lifting. Plans are underway at Interface to include their products and services in the Evergreen Lease programme, too. Line Anthem Corporation and Bank America Credit Corporation are financial partners on the Evergreen Lease Programme. Carpet Maintenance Service, Inc. (Dallas, Texas) and Interior Preservation, Inc. (Oakland, New Jersey) are agents of Re:Source Americas, the installation arm of Interface, and they provide carpet maintenance programmes. Raw materials suppliers such as BASF Fibers and DuPont provide yarn products with partial post-industrial recycled content. In addition, DuPont has created a product reclamation network that feeds into a recycling plant in Chattanooga, Tennessee, where old material is sorted, recycled, or converted into energy. Other partners in Interface's recycling effort include Reudenberg, LaGrange Molding, and Odgen Martin.

The vision

Interface continues its journey on the path to sustainable processes with the Evergreen Lease and thousands of other little steps, as well as a few big ones, such as developing renewable energy sources to drive its production processes and eliminating scrap and emissions throughout its process. If it can master closed-loop recycling, renewable energy sourcing, and scrap and emissions elimination (converting linear processes into cyclical processes), Interface will be sustainable and will never have to take another drop of oil from the Earth. Rather, the company intends to spend the rest of its days harvesting yesteryear's carpets and other petrochemically derived products and recycling them into new materials, and converting sunlight or wind into energy; with zero scrap going to landfill and zero emissions into the ecosystem.

The Evergreen Lease is a manifestation of what Paul Hawken, Bill McDonough, Michael Braungart, and others have called "licensing" or "products of service."[1] It's the future, not just for carpet but for a wide range of manufactured products. Interface is grateful to Southern California Gas Company and the Energy Resource Center, and to John Picard, for driving this concept to a reality and inviting Interface to be a participant. However, it will take the cooperation of many for the Evergreen Lease to become broadly successful: designers and facility managers who will need to approach flooring specification differently, financial institutions who will need to participate in leases without terms or determined salvage value, and suppliers who will need to continue to work to close the loop on recycling.

Notes

1. See, for example, Paul Hawken, *The Ecology of Commerce: A Declaration of Sustainability*, HarperCollins, New York, 1993, pp. 67-69.

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Why a double issue?

Because we intended to address the subject of product design and the environment in the broadest sense, from both the design and market points of view.

The issue contains fifteen articles – against eight in a regular issue – covering the two separate but interrelated topics of ecodesign and market transformation.

We hope you have enjoyed reading the material and welcome your comments, which you can send by e-mail to unepie@unep.fr.

Environmental auditing of a Mauritian textile dyeing factory

M. Allybokus, N. Lebrette and T. Ramjeawon, Faculty of Engineering, University of Mauritius, Reduit, Mauritius

Abstract
This article examines the application of environmental auditing to identify possible ways to achieve cleaner production in a textile dyeing factory. Research focusing on wastewater was carried out in three phases: a pre-assessment phase for audit preparation; a data collection phase in which a material balance was derived; and a synthesis phase. Ways to minimize waste through process modification are discussed.

Résumé
Cet article présente un exemple d'application des audits d'environnement dans une usine de teinture de textiles : il s'agit ici d'identifier les possibilités de produire plus propre. Cette recherche, axée sur les eaux usées, s'est déroulée en trois temps : une phase d'évaluation préliminaire pour rédiger l'audit ; une phase de collecte de données qui a permis de dresser un bilan-matières ; et une phase de synthèse. L'article analyse les possibilités de réduire la production de déchets par des modifications des procédés.

Resumen
Este artículo estudia la aplicación de la auditoría medioambiental para identificar las posibilidades de lograr una producción más limpia en las fábricas de tintura textil. Se llevó a cabo la investigación sobre aguas residuales en tres fases : una de evaluación previa para la preparación de la auditoría, una fase de recogida de datos en la cual se obtuvo un balance material y una de síntesis. Se están estudiando los medias para minimizar los residuos mediante la modificación de procesos.

Introduction

Mauritius, a small island of 1865 km^2 in the Indian Ocean, has limited arable land capacity. Exploitation of this land has more or less reached its limit. The monocrop foreign exchange earner, sugar cane, is often exposed to tropical cyclones and there is limited scope for its expansion or that of its by-products. To cope with problems such as rapid inflation, soaring unemployment, and acute foreign exchange shortages, industrial development has been encouraged. The Mauritian Government endeavoured to stimulate both export-oriented and import-substituting enterprises by launching the Export Processing Zone (EPZ) in 1971, with various incentives provided to potential investors. The accessibility of Mauritian textile products and garments to the European market proved very important in the development of the EPZ. However, this was subject to certain constraints. To overcome them, Mauritius encouraged a process of vertical integration in the textile sector through the introduction of such processes as spinning, weaving, dyeing, and finishing to raise the value added. These processes ensured that the imported goods had undergone sufficient transformation to enter the EU market duty-free.

Textile industries operating in the EPZ sector have dominated the industrialization programme. In 1995, they had a 66 per cent share of the EPZ, which totaled 574 enterprises and employed some 80,000 workers. The export performance of the EPZ has been extremely impressive during the period 1983-1995. Exports from the EPZ rose from a mere Rs 1.2 billion in 1982 to some Rs 15 billion in 1995. The export proceeds from textiles and clothing amount to 82 per cent of total EPZ exports and 57 per cent of total exports for the country. However, raw materials (excluding machinery and chemicals) account for over 60 per cent of the total EPZ exports (MEPD, 1993).

As a result of vertical integration within the textile sector, the number of dye houses increased from six in 1984 to 48 in 1990. Disposal of the effluents produced began to pose problems. Haphazard disposal to watercourses and the soil, and the subsequent environmental problems, prompted the authorities to promulgate certain standards for the discharge of wastewater (MOEQL, 1991). These standards are ill-defined and very often place emphasis on the wrong parameters (Allybokus, 1993). The need to rapidly satisfy the authorities has forced the industries to opt for turnkey projects, whereby the supplier designs and equips the treatment plant. However, in most cases the plants have performed poorly because of poor design and lack of technical know-how in regard to plant operation and maintenance.

Environmental awareness has led to a change in consumption patterns, with goods believed to be environmentally "safe" in greater demand. The International Organization for Standardization is due to publish an international standard by the end of this year, the ISO 14000 series, an internationally agreed set of criteria to evaluate the environmental profile of a company with respect to its product and its manufacturing process (ISO, 1995). The emergence of such non-tariff barriers will threaten the export sectors of developing economies. Mauritian textile dyeing factories will need to introduce the concept of integrated environmental management, failing which they will lose their competitive edge on foreign markets. In the coming years, the factories will be required to demonstrate a level of control of their total impact on the environment by adopting an Environmental Management System.

The environmental auditing tool

Complex environmental issues demand a comprehensive, integrated approach to tackle the problems of pollution. Reductions in the use of water, energy, and other raw materials, along with waste minimization and elimination, should have the highest priority. Cleaner production, covering both products and manufacturing processes, is both necessary and beneficial. This implies that all types of resources, during the entire product life cycle, should be used as optimally as possible to reduce environmental impacts. In a textile process, this can mean, for example, substituting a toxic chemical, reducing water flows, changing operational parameters, recovery of chemicals, and replacement of high BOD chemicals by low BOD ones. The economic advantages gained by implementing cleaner production are two-fold: it will reduce the costs of production and the need for costly end-of-pipe pollution control facilities, while simultaneously reducing health and environmental impacts. Environmental auditing provides the analytical tool for assessing critically the environmental performance of a production process. At the level of an individual industrial plant, it consists of two main activities :

- a waste reduction audit to critically examine the production process and to identify possibilities for waste minimization;
- an environmental compliance audit, which assesses the degree of compliance with prevailing standards and the ability to cope with future legislation.

The environmental auditing management tool, focusing on wastewater, was applied to a typical Mauritian textile dyeing factory so as to identify

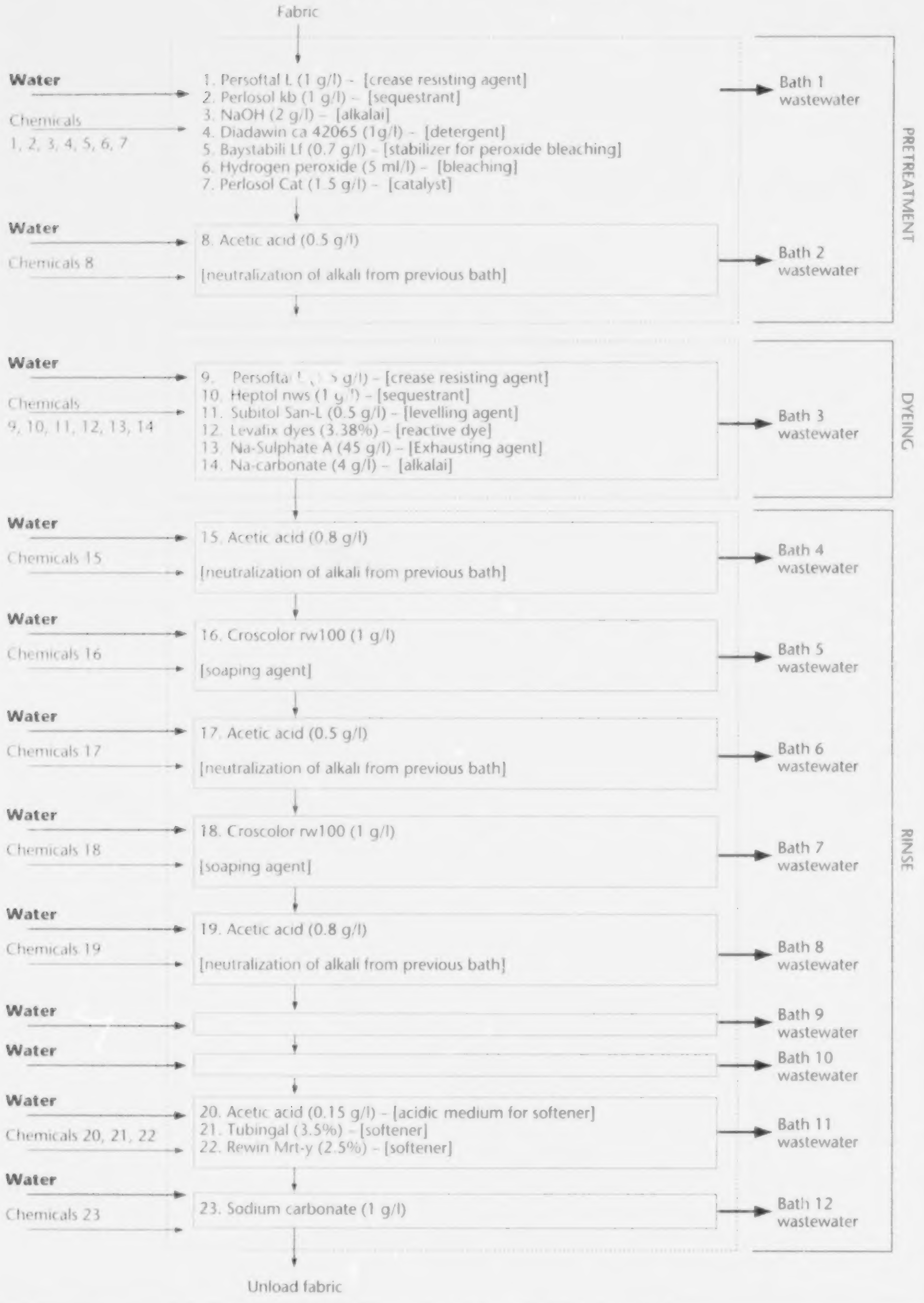
Fabric
Water
Chemicals 1, 2, 3, 4, 5, 6, 7
1. Persoftal L (1 g/l) - [crease resisting agent]
2. Perlosol kb (1 g/l) - [sequestrant]
3. NaOH (2 g/l) - [alkalai]
4. Diadawin ca 42065 (1g/l) - [detergent]
5. Baystabili Lf (0.7 g/l) - [stabilizer for peroxide bleaching]
6. Hydrogen peroxide (5 ml/l) - [bleaching]
7. Perlosol Cat (1.5 g/l) - [catalyst]
Bath 1 wastewater
Water
Chemicals 8
8. Acetic acid (0.5 g/l)
[neutralization of alkali from previous bath]
Bath 2 wastewater
PRETREATMENT
Water
Chemicals 9, 10, 11, 12, 13, 14
9. Persoftal L (.5 g/l) - [crease resisting agent]
10. Heptol nws (1 g/l) - [sequestrant]
11. Subitol San-L (0.5 g/l) - [levelling agent]
12. Levafix dyes (3.38%) - [reactive dye]
13. Na-Sulphate A (45 g/l) - [Exhausting agent]
14. Na-carbonate (4 g/l) - [alkalai]
Bath 3 wastewater
DYEING
Water
Chemicals 15
15. Acetic acid (0.8 g/l)
[neutralization of alkali from previous bath]
Bath 4 wastewater
Water
Chemicals 16
16. Croscolor rw100 (1 g/l)
[soaping agent]
Bath 5 wastewater
Water
Chemicals 17
17. Acetic acid (0.5 g/l)
[neutralization of alkali from previous bath]
Bath 6 wastewater
Water
Chemicals 18
18. Croscolor rw100 (1 g/l)
[soaping agent]
Bath 7 wastewater
Water
Chemicals 19
19. Acetic acid (0.8 g/l)
[neutralization of alkali from previous bath]
Bath 8 wastewater
Water
Bath 9 wastewater
Water
Bath 10 wastewater
Water
Chemicals 20, 21, 22
20. Acetic acid (0.15 g/l) - [acidic medium for softener]
21. Tubingal (3.5%) - [softener]
22. Rewin Mrt-y (2.5%) - [softener]
Bath 11 wastewater
Water
Chemicals 23
23. Sodium carbonate (1 g/l)
Bath 12 wastewater
RINSE
Unload fabric

Figure 1
Example of a typical dyeing sequence for cotton

possible means of achieving cleaner production. The approach [Source: UNEP (1991)] comprised three phases: a pre-assessment phase for audit preparation; a data collection phase to derive a material balance; and a synthesis phase in which the findings from the material balance are translated into a waste reduction plan and cleaner production strategies are worked out.

Dyeing of cotton and wool

The factory audited employs some 1250 workers and is concerned mainly with the washing and dyeing of wool and cotton garments. About 65 per cent of production deals with wool and the remaining 35 per cent with cotton. The production on a monthly basis is shown in **Table 1**. In addition to these two major activities, minor processes like stone and sand washing and button dyeing are carried out at the factory.

The factory operates on a 24-hour basis, with three shifts a day six days a week.

The recipe for the dyeing of cotton or wool can be divided into three steps: the pretreatment, the dyebath and the final rinse. A typical example of a recipe for the dyeing process for cotton is outlined in **Figure 1**. During pretreatment, the cotton fibres are degreased and treated to open the fibre structure. The dyestuff is poured into the dyebath, and diffusion of the dyestuff molecules between the cellulose fibres takes place. The rinse normally consists of several rinsing baths.

Water consumption and wastewater

Water used in the factory is taken from a river and from boreholes, filtered through a pressure filter, and stored in a tank for subsequent use.

The factory uses six computer-operated dyeing machines (Dytex 54) and seven manually operated dyeing machines (side paddles) for its operations. The volume of water consumed by the Dytex machines is 1500 litres per cycle, while for the side paddle machines it varies between 1500 and 4000 litres. If the same liquor ratio of 1:35 is used in all dyeing operations, for washing or machine wash processes the manually operated machines are less efficient. This fact is made obvious when the annual water consumption of the different activities is examined.

Flow diagrams were established for each process and, together with the daily batch reports, the total water input to the factory was estimated at about 350,000 m^3/year. This amount includes the water used in the stone and sand washing section, the button dyeing section and the boiler house. Estimates of the maximum water consumption per different area of activity are shown in **Table 2**.

Samples of effluents from the dyehouse were collected at a point in the drainage system where effluents from all the different streams mix. The results obtained from the analyses carried out are given in **Table 3**.

From data on production, water consumption and effluent characteristics, it is estimated that the waste load is as follows:

COD = 230 kg/tonne of garments
BOD = 60 kg/tonne of garments
TSS = 20 kg/tonne of garments

These values compare favourably with the values published by UNEP (1994).

The presence of heavy metals in effluents from dyehouses often gives rise to concern because of the problems generally associated with the accumulation of heavy metals in the environment. Heavy metals present in dyebaths originate either from the dyes themselves or from the potassium dichromate added to the dyebath. The results in four different dyebaths for some selected metals are shown in **Table 4**.

Apart from the chrome which may exist in free state because of the addition of potassium dichromate to the dyebath, the rest of the metals are bonded to the dye molecules. However, due to a combination of factors such as temperature and pH, during dyeing some hydrolysis does occur. This will liberate a certain amount of heavy metals. Taking into consideration the available dilution at the dyehouse and within the sewage network, it is most likely that the heavy metals concentration would be well within recommended limits.

The wastewater treatment system at the factory consists essentially of a pH equalization tank and a conventional activated sludge system. The final effluent is pumped into the sewage system. The plant's BOD and COD removal efficiencies are poor, at around 25 per cent. The following observations were made as regards the wastewater treatment plant:

- The dissolved oxygen (DO) concentration in the aeration unit was extremely low, at about 0.3 mg/litre. The average temperature in the aeration unit was 32°C.
- There was a lot of foaming in the aeration unit.
- The Mixed Liquor Suspended Solids Concentration (MLSS) was very low.

Cleaner production approach and process modification

Cleaner production aims at minimizing the pollution problem at source rather than allowing the pollution generated at different stages during the production process to build up. Implementation of appropriate cleaner production techniques may lead to reduction in production costs and, at the same time, minimize the cost of end-of-pipe treatment. The water consumption and wastewater disposal rates for industrial consumers are summarized in **Table 5**.

Cleaner production can be achieved through the following strategies:

- water and energy conservation;
- optimization of chemicals;
- process modification.

At present, all the water used for rinsing, either pre- or post-dyeing, is discharged together with the water used for other processes. Water conservation could be achieved if part of the water used in the various rinsing processes could be recovered and reused at some stage in the dyeing process. Before this option can be considered, however, it is essential that the effluent from the different operations involved in one dyeing process be fully characterized. **Tables 6** and 7 show the average characteristics of baths following typical cotton dyeing and wool dyeing sequences, respectively.

Table 1
Production of finished garments in 1995

Process	Production (kg/month)
Washing and finishing	120,000
Dyeing	20,000
Machine washable	40,000

Table 2
Estimates of annual maximum water consumption for each area of activity at the factory

Dytex machine (computer operated)	125,000 m^3
Side paddle machine (manually operated)	175,000 m^3
Boiler house	125,000 m^3
Sampling section	25,000 m^3
Sand washing	7500 m^3
Stone washing	3500 m^3
Button dyeing	2 m^3

Table 3
Dyehouse effluent characteristics

Parameter	Mean
Flow rate	1120 m^3/day
COD	1479 mg/litre
BOD$_5$	370 mg/litre
NH$_3$-N	7.1 mg/litre
Solids	
TSS (Total Suspended Solids)	123 mg/litre
TDS (Total Dissolved Solids)	320 mg/litre
TS (Total Solids)	5613 mg/litre
TVS (Total Volatile Solids)	5367 mg/litre
Chromium	0.15 mg/litre
pH	6.9
Temperature	34.9 °C

Table 4
Heavy metal concentrations in dyebaths (mg/litre)

Metal	Wool dyeing		Cotton dyeing	
	"Chrome"	Reactive	Reactive (1)	Reactive (2)
chromium (total)	2.97	<0.4	<0.4	<0.4
manganese	0.59	0.53	0.19	<0.02
Copper	0.08	0.08	5.73	0.24
Nickel	<0.1	<0.1	2.78	2.97
Zinc	2.03	1.58	2.02	1.77
Iron	0.15	0.66	0.13	0.20

From the data on the characteristics of the effluents from the different cotton dyeing process streams, it is observed that most of the pollutants, in terms of concentration, are found in baths N°s 1 and 3. Bath N° 1 results from the scouring process. During that process the fabric is prepared for subsequent dyeing. If the process is not carried out properly, there will be adverse effects on the dyeing process and the fabric will not be dyed properly. Thus, from the point of view of a cleaner production approach, the engineer has little or no control over that phase of the production process. The only recommendation that the engineer can make is that detergents with high biodegradability be used. These detergents are more expensive, but their effect on effluent treatment processes and receiving bodies is less deleterious.

Bath N° 3, the dyebath, has been prepared and tested by the dyemaster to meet the particular order of a customer. Here again the engineer has no control except to recommend the use of environmentally friendly chemicals and auxiliaries.

Baths N^{os} 4 to 12 result from processes such as neutralization with acid to remove excess alkali, soaping to remove unfixed dyes, and the addition of softeners under acidic conditions. There is potential for saving water at this end. If dyes with a greater affinity for the fabric, which are more expensive, are used, this will definitely reduce the number of rinsing operations needed. As the process stands, baths N^{os} 10, 11 and 12 are reasonably clean and, as they are very low in colour, can certainly be reused. Ideally, the water should be sent back to the raw water storage tank for filtration prior to reuse in the dyeing process. This approach will minimize the risk of cross-flows and possible adverse effects on processes.

As regards wool dyeing, bath N° 4 is almost colourless and has a low concentration of organic matter, such that it is almost comparable to the raw water abstracted from the river. This bath should be segregated from the other baths and sent back to the raw water tank for filtration and reuse. The necessity of bath N° 5 needs to be ascertained. In this bath only acetic acid is added, and the exact reason for the acetic acid rinse is ill defined.

The segregation of these four baths, which is technically feasible, would lead to a reduction in water consumption of about 75,000 m^3/year, i.e. around 20 per cent of the total water used by the dyehouse.

Conclusion

On the basis of the environmental auditing exercise within the textile dyeing factory, which focused on wastewater, the following processes were pointed out as priority areas for intervention for cleaner production:

- The consumption of chemicals and water in the rinse for cotton dyeing has been found to be significant. About 60 per cent of the total COD discharge of the recipe is related to auxiliary chemicals used in the rinse, and about 75 per cent of total water consumption is related to the rinse. The improvement potential in the rinsing procedure is significant, and new recipes that focus on improvements in the rinse need to be developed. If cleaner technology were applied to this factory, it would lead to a reduction in water consumption of around 75,000 m^3/year. Based on water consumption and sewage disposal rates, it is estimated that this would lead to a savings of about US$ 50,000 annually. One major obstacle to pollution prevention in factories is that companies are sceptical about the potential benefits of pollution prevention and hesitate to invest in source reduction. Such projects need to be justified on an economic basis.

◆ The increasing demand for shade- and washfastness from the textile industry means that the dyehouses should use secure and reliable recipes. Dyebaths used to produce the desired shades are obtained after a series of trials. This necessitated the use of about 25,000 m³/year of water in the factory studied during this project, and the resulting recipes are closely guarded secrets. In this area the environmental engineer has little or no control. It is the responsibility of the dyemaster to ascertain that environmentally friendly materials are used in the dyebaths, especially in view of the fact that, with the adoption of the ISO 14000 series, the use of certain types of dyes (such as chrome and sulphur dyes) would be banned.

◆ Membrane filtration of the rinsing water needs to be investigated, as it is documented that it saves chemicals, water and production time.

◆ The need to rapidly satisfy the authorities with ill-conceived effluent standards has forced the industries to opt for turnkey plants, which, as in the case studied, perform badly because of poor design and lack of technical know-how in regard to plant operation and maintenance.

Table 5
Water consumption and wastewater disposal rates for industrial consumers in 1996

	Rate (US$ per cubic metre)
Water consumption	first 100 cubic metres : 0.4 next 150 cubic metres : 0.45 all additional cubic metres : 0.55
Effluent disposal *	0.1

* disposal into sewers, which ultimately discharge into sea outfalls after only preliminary treatment

Notes

[1] All correspondence should be addressed to Dr Allybokus.

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Table 6
Average characteristics of baths following a typical cotton recipe dyeing

Bath	Appearance	Temp °C	pH	Colour Pt/Co	Conductivity micro S/cm	TDS mg/litre	TSS mg/litre	COD mg/litre	BOD5 mg/litre	Nitrate-N mg/litre	Nitrite mg/litre	Sulphate mg/litre	Alkalinity		Hardness mg/litre
													Total mg/litre	*Free* mg/litre	
1	Turbid (yellowish)	70	11.00	280	7980	5011	1618	4311	1900	42.0	0.207	16	2430	1070	200
2	Slightly turbid	35	6.50	85	1120	703	152	1009	550	18.0	0.049	27	430	0	120
3	Dark green	60	10.30	475	27,000	16,956	88	4034	1050	4.8	0.016	30000	2500	770	164
4	Green	40	7.15	467	7950	4993	188	448	250	1.2	0.000	3900	190	0	40
5	Green	80	7.04	470	3800	2386	116	468	278	0.6	0.017	1900	120	0	120
6	Green	60	7.00	431	1335	838	60	450	150	4.8	0.018	650	100	0	100
7	Green	80	7.10	244	1602	1006	100	379	91	1.1	0.016	250	120	0	300
8	Pale green	60	7.00	95	601	377	24	200	104	0.0	0.009	25	80	0	40
9	Pale green	40	7.00	57	304	191	24	64	39	6.5	0.006	20	81	0	8
10	Almost colourless	30	7.00	1	173.7	109	76	50	15	1.2	0.007	17	38	0	33
11	Turbid	40	5.00	10	459	288	60	100	35	9.8	0.106	8	41	0	24
12	Colourless	30	5.00	1	976	613	4	20	6	16.0	0.015	18	340	140	72

Table 7
Average characteristics of bath following a typical wool recipe dyeing

Bath	Appearance	Temp °C	pH	Colour Pt/Co	Conductivity micro S/cm	TDS mg/l	TSS mg/l	COD mg/l	BOD5 mg/l	Nitrate-N mg/l	Sulphate mg/l	Phosphorus mg/l	Alkalinity		Hardness mg/l	Ammonia-N mg/l
													Total mg/l	*Free* mg/l		
1	Dark brown	60	5.10	500	3610	2267	144	2575	1438	0.0	920	415.00	152.00	0	400	16
2	Dark brown	80	8.50	495	1410	885	50	1480	750	0.0	560	205.00	480.00	60	130	280
3	Brown	60	6.50	154	324	203	12	322	163	0.0	180	0.04	20.0	0	110	39
4	Almost colourless	35	7.00	6	215	135	2	10	2	1.7	37	0.09	58.0	0	80	6
5	Colourless	30	5.00	0	395	248	3	553	378	2.0	25	0.20	18.0	0	80	11

Sustainable development in China's paper-making industry

Yang Faming and Wu Xiaobo, School of Management, Zhejiang University, Hangzhou, 310027 People's Republic of China

Abstract

The paper-making industry is one of the main sources of water pollution in China, which hinders the attainment of sustainable development considerably. In this article the problems facing the paper-making industry are analysed and measures which need to be taken in order to arrive at sustainable development in this industry are suggested.

Résumé

L'industrie des pâtes à papier est en Chine l'un des plus gros consommateurs d'eau et l'un des principaux facteurs de pollution de l'eau. Cet article analyse les problèmes auxquels est confrontée l'industrie chinoise des pâtes à papier et suggère des mesures pour parvenir à une production écologiquement viable. Il s'intéresse plus particulièrement aux PME de la province de Zhejiang.

Resumen

La industria papelera es uno de los grandes consumidores y contribuidores a la contaminación del agua en China. Este artículo analiza los problemas que encuentra la industria papelera de ese país y propone medidas para lograr una operación sostenible. Se presta una atención particular a las empresas papeleras pequeñas y medianas en la Provincia Zhejiang.

Background

Between late 1993 and the beginning of 1994, we visited a number of government executive bureaus and business organizations in China's paper-making industry, surveyed eleven small and medium-sized enterprises (SMEs) in this industry, and questioned more than 30 SMEs in the paper-making industry in Zhejiang Province in order to study the sustainable development of SMEs and, in particular, to carry out a situation analysis of the coordinated development of paper production and environmental protection.

Characteristics of paper-making in SMEs

As the most evident characteristic, water (consumption of fresh water and emission of wastewater) is essential to the development of the paper-making industry.

High water consumption

Paper-making is a typical high water consumption industry. Huge amounts of water are used in the process of paper-making, and it is overused in paper-making SMEs, especially in township SMEs because of their technological backwardness. In an investigation of more than 30,000 township SMEs by the Zhejiang Environment Protection Bureau (EPB) in 1990, water consumption for paper-making was 31.45 per cent of total water consumption, though the total output value of paper-making products was only 1.99 per cent of total output and its water consumption per 10,000 RMB yuan output value was 1400.1 tonnes, much higher than in other industries (see **Table 1**).

High wastewater and pollutant emissions, low disposal ratio

Because of the paper-making process, while the industry is one of the highest consumers of water, its wastewater emissions are also the third highest among the nation's industries and the highest among Zhejiang Province's industries. And there exist problems in wastewater disposal. Paper-making has become one of the largest sources of pollution (see **Table 2**).

High wastewater emission

The total output value of paper-making is only 1.32 per cent of that of all industries of China, but its wastewater emission was 9.3 per cent of that of all industries in 1991. In Zhejiang Province, wastewater emission from paper-making was 35 per cent of that of all industries, making it the greatest wastewater emitter among all industries.

High pollutant emission

Though the wastewater emission of the paper-making industry is only around 10 per cent of that of all industries combined, the ratio of pollutant emission to that of all industries is much higher. For example, BOD was 25 per cent of that of all industries. In Zhejiang Province, the percentage pollutant emission by the paper-making industry is even higher than nationally (see **Table 3**).

Low disposal ratio

In 1991, the standardized wastewater emission ratio was 50.2 per cent, but that is only 13.1 per cent in the paper-making industry (**Table 2**). The ratio is even lower in township SMEs (see **Table 4**).

The unfavourable current situation and the tendency towards uncoordinated development

The negative effects of the high growth rate of paper-making SMEs and the even higher rate of increase in pollution

Since the liberation in 1949, the paper-making industry has developed so fast that its total output value has increased 134.5 times. In recent years, it has developed even faster in Zhejiang Province. From 1985 to 1991, paper production increased at an annual rate of 8.41 per cent and 9.56 per cent in the nation and in Zhejiang Province, respectively.

From 1981 to 1991, the annual increase in wastewater emission from paper-making was 15 per cent. This was much higher than the annual growth rate of paper production, which was 9.7 per cent.

The structure of negative effects

The decrease in large-scale production

When we appraise the rapid development of China's economy in recent years, we should look at the township SMEs' great contribution first. The rate of increase in the number of township SMEs is above 20 per cent annually. The relation of industrial value added of large-, medium- and small-sized enterprises in Zhejiang province is 18:20:62. The contribution of SMEs is over 80 per cent.

In 1990, due to poor business administration, the nation's state-owned large-sized enterprises (LEs) decreased their paper production by 2.54 per cent, while the township SMEs' paper production increased 10.87 per cent. In Zhejiang Province, total paper production decreased 12.5 per cent. In 1992, 20 per cent of state-owned paper-making enterprises suffered heavy losses, but the township SMEs increased their paper production by 28.26 per cent. So the changing tendency of the scale structure of paper-making enterprises is developing in an unfavourable way.

That this tendency is unfavourable is shown in following facts:

In 1991, the total output value of township paper-making SMEs was only 2.76 per cent of that of all industries, while their wastewater emission was 44 per cent of that of all industries. The township paper-making SMEs' wastewater disposal ratio was three-fourths of that of LEs in cities, while the standardized wastewater emission was only one-fourth that of cities.

According to an investigation made by China's Light Industry Ministry, the average production of

Table 1
Water consumption in major industries

Industries	Output value (10^4 yuan/year) and % of total output	Fresh water consumption (tonnes/year) and % of total consumption
Paper-making	46,458.0 (1.73%)	6535.0 (31.54%)
Dyeing	377,349.0 (14.08%)	2771.8 (13.34%)
Chemical	581,969.0 (21.83%)	1891.0 (9.08%)

Data source: Zhejiang Environment Protection Bureau

Table 2
China's wastewater emission and disposal

	Total wastewater emission	Standardized wastewater emission		Wastewater disposal	
		Amount	Ratio	Amount	Ratio (%)
Paper	220,418	28,973	13.1 per cent	2519	1.14
Total industrial	2,360,000	1,180,000	50.2 per cent	1,670,000	70.76

* The ratio is % of total wastwater emission, and the unit is 10,000 tonnes.

***Data source: Yearbook of China 1992*

township paper-making enterprises is 300 tonnes per year. Seventy per cent of the enterprises use the backward process of lime pulp-making and have almost no equipment for alkaline retrieval.

It is reported that in Xingxiang County, Henan Province, the 63 paper-making SEs produced 50.5 thousand tonnes of low-quality paper annually, while at the same time emitting tens of millions of tonnes of wastewater, causing severe water pollution. Only 15 rivers out of 161 were not polluted. Farmers could only drink water pumped from wells.

Deterioration in raw materials

Because of the important relations between pollution and raw material use in paper-making, the relevant national department proposed in China's Seventh Five-Year Plan nearly ten years ago that there should be a gradual increase in the ratio of wood pulp in paper-making. However, the implementation results are very disappointing (see Tables 5 and 6).

The techno-economic analysis of paper-making SMEs

Through techno-economic analysis, we can explore the potential of raising the disposal efficiency of wastewater emission.

Water consumption per unit output value

Water consumption per unit output value is basically decided by the nature of the production process. However, when an investigation was made of different paper-making SMEs, it was found that the water consumption ratios differed greatly between similar sized enterprises due to their different management styles. Here we do not explore the management reasons for these differences, but do generally explore the potential to raise water consumption efficiency.

It is estimated by expert consulting that reasonable water consumption would be around 900 tonnes per 10,000 RMB Yuan output value. So the potential saving in water consumption by paper-making SMEs in Zhejiang Province could be estimated at 25.3 per cent.

Though this water saving ratio is not so high, the potential saving is as great as the amount of water consumption in paper-making is great, which could also eliminate much more pollutant emission.

The ratio of wastewater emission to output value

Further, when we look into the differences in the ratio of wastewater emission to the output value among paper-making SMEs, we see more clearly the potential for pollutant reduction (see **Table 7**). In the table, the highest ratio is 6.6 times higher than the lowest. Here we should notice that one of the main causes is the difference in paper-making process, especially the raw material used. It is much more difficult to reduce wastewater emission from SMEs that use straw pulp than from those that use wood pulp.

Raw material leakage in the paper-making process

Because township paper-making SMEs lack the equipment to retrieve black water and alkaline, a large amount of harmful materials leak to emission. BOD, COD, suspended solids, and volatile phenol are emitted much more in paper-making than other industries. Directly, the leakage is caused by three factors: low material utilizing rate, low end product rate, and poor management system. The first two factors are directly related to poor equipment investment. However, we found it was difficult for township SMEs, especially SEs, to invest in pollution disposal equipment, as they invest less than 200,000 Yuan to build a paper-making mill and the money needed to dispose 1 tonne of wastewater (according to our investigation) is 1.66 Yuan.

Technology development in paper-making SMEs

Technology transformation

Generally speaking, the greater the technology capability, the more efficient pollution disposal will be, as the material leakage and wastewater emission are reduced. And as we have shown above, the smaller paper-making enterprises are, the more difficult it is to reduce pollutant emission. Thus, a good way for paper-making SMEs to operate sustainably is to enlarge the production scale through technology transformation. Taking the scope limits of the paper market into consideration, some of the SMEs with high pollution and low profits should be closed.

Technological innovation

Almost all of the paper-making SMEs we investigated lack R&D capability. However, we found one small paper-making firm, Xinshi Paper making Mill in Deqing County, Zhejiang Province, which undertook technological innovation successfully. The small mill produces less than 2000 tonnes of paper annually. With the help of experts in large state-run research centres, it innovated a new process to produce paper with waste

Table 3
Pollutant emissions from paper-making in Zhejiang Province
(unit: 10,000 tonnes)

	Alkaline water	Acid water	Toxic water	Non-toxic but harmful water	Above pH quota water	Above SS quota water	Above COD quota water	Volatile phenol (tonne)
Paper	2358	24.5	224.9	5192	2383	4529	4936	18
Ratio to all emissions (%)	43.5	0.45	4.15	95.8	44.0	83.59	91.1	52

Data source: Zhejiang Environment Protection Bureau

Table 4
Township paper-making SMEs' wastewater disposal in Zhejiang Province
(unit: 10,000 tonnes)

	Wastewater per 10^4 Y output value	Disposed wastewater		Standardized wastewater emission	
		Amount	Ratio (%)	Amount	Ratio (%)
Paper	0.11664	1811.9	33.44	274.4	5.06
Total industrial	0.00629	4199.5	35.31	3146.5	21.0

Data source: Zhejiang Environment Protection Bureau paper which solved the problem of waste paper's ink separating. The firm avoided the heavy pollution of using straw pulp and avoided the fate of closing, with both a small amount of paper production and a small amount of pollutant emission. This a good way for small firms to make innovations with the help of external experts, and is also an important example of the need for government to establish communication networks among SMEs and research institutes.

Technology acquisition

There exist large gaps between the efficiencies of domestic equipment and foreign equipment in paper-making, as China is still a developing country. Further, when we take an adequate cost-benefit ratio into consideration, technology acquisition is a good way to help SMEs improve their pollution disposal, as one of our sample firms shows in practice (see **Table 8**).

The main problems

In conclusion, we found that the main problems in regard to the sustainable operation of paper-making SMEs could be categorized into the following two aspects: techno-economic characteristics, and pollution control management systems.

Techno-economics

1. Scale

It is obvious that the scale of paper-making is positively related to pollution treatment. In our investigation, all the large-sized paper-making firms had alkaline retrieval equipment. For example, Huafong Paper-making Co. has an alkaline retrieval workshop. The alkaline retrieval ratio reached 80 per cent, while almost all the small paper-making firms have no such equipment and pollution by alkaline emission is very serious.

2. The nature of paper products

Almost all of the small paper-making firms produce primary paper products. Over 70 per cent of their products are primary paperboard and corrugated paper. The corresponding production processes are also very simple and crude. For example, almost all of these firms use straw pulp or hemp pulp and dispose pollutants with lime. Thus, it is hard for those firms to eliminate pollutants.

3. Investment

In our investigation, we found that almost all the small paper-making mills were established with an investment of less than 500,000 RMB Yuan each in underdeveloped areas, as a way to get rid of poverty. Thus, it is very difficult for their not-so-rich investors to invest in pollution control.

Pollution control systems

SMEs are much different from LEs in their pollution control systems. Generally, SMEs are much more disappointing than the LEs.

1. Specific department and professionals

Under government regulations, all LEs should have a specific department and professionals in charge of pollution control. However, few SMEs, especially SEs, actualy have these. Such a situation is very serious in paper-making SMEs. It was established by the Zhejiang Environment Protection Bureau that on average the pollution control professionals in paper-making township SMEs consisted of 11 people per 100 enterprises, and that there were on average 40 professional people in 100 township SMEs in Zhejiang Province.

Table 5
Relations between raw material and pollutant disposal

Pulps	Black water retrieval (%)	Alkaline retrieval (%)
Straw	75-88	50
Wood	90-95	80-93
Hemp	20	No effective way

Data source: Zhejiang Light Industry Administration Bureau

Table 6
The changing structure of raw material adoption (%)

Raw materials	1985	1986	1990
Straw	73	74	80
Wood	22.8	21	14.2

* 46 per cent of the world's non-wood pulps was used in China in 1986, including 75 per cent of the world's straw pulp. China is the world's largest user of non-wood pulp, though it also imports more than 500,000 tonnes of wood pulp annually.

Data source: Zhejiang Light Industry Administration Bureau

Table 7
Ratio of wastewater emission to output value in typical paper-making SMEs

	SME A	B	C	D	E	F
Wastewater/ output (tonne/ 10^4 Yuan)	1070.0	895.9	417.6	1215.6	2746.6	1166.4

2. Confused integration of government administration and firms' management

In cities there are many more firms under government administration than in the countryside. Therefore, the interrelation between government and firms is much more direct and complicated in the countryside. It is almost impossible for city governments to rely for their achievements on a few individual firms, but it is the reality in the countryside. Generally the township SMEs are in a close relation with the local government. The complicated relation between township SMEs' profit-making activities and government officials means that the government administration is confusedly integrated with firms' management. In recent years the local governments' achievements have been mainly examined in terms of the increase in local output value. The environmental situation is almost ignored, and the local governments take little interest in environmental conservation and even interfere with the environment protection departments' activities to maintain their "achievements", which is very harmful to pollution control.

3. Firms' myopia concerning benefits

Environmental control generally increases production cost directly, especially to township SMEs. As achievements are measured by direct profits, the SMEs' managers are thirsty to earn more direct profits, and the employees, the former poor peasants with a poor educational background, are thirsty to get rid of poverty. Little care is taken to protect the environment, and the central government's policies and regulations are difficult to implement in vast and rapidly developing rural areas.

Implications and policies

As a result of the above analysis, we could arrive at the following policy and countermeasure implications:

Technical policies

1. Strict lower limits

In regard to small paper-making mills in the countryside in Zhejiang Province, the small mills with daily production below 25 tonnes of paper using straw pulp should be forced to transform their processes to avoid straw pulp production and treatment with lime, and those whose production is below 15 tonnes pulp/day and with higher pollution and lower profits should be forced to close or be encouraged to form groups in order to achieve economies of scale in pulp production.

2. Preferential treatment

In accordance with the relation between the scale of enterprises and techno-economic-ecological benefits, preferential tax treatments, favourable loans, and other business administration benefits should be given to large paper-making firms and those SMEs using wood pulp and commercialized pulps produced by large-scale producers, which currently only make up 1.7 per cent of the total. The policy of "first developing LEs, then constraining SEs" in the paper-making industry should be favoured, as the closing of many small paper mills would result in an increase in the paper price and thus in spending more exchange on imported paper. The small paper mills should be closed step-by-step, not in one night.

3. Promoting the centralization of pulp production

Government should support the establishment of centralized pulp-making enterprises, especially in the rural areas with a high density of small paper-making mills. Some typical-model enterprises or groups should be formed with the guidance and support of government in order to test the feasibility of this proposal.

4. Centralized emission disposal

Centralized emission disposal could benefit not only the paper-making industry but also other industries. For example, the centralized disposal of paper-making emissions along with chemical industry emissions could achieve complementary effects. It has been shown that the central disposal of paper-making and chemical emissions could save 40 per cent of operational costs and 30 per cent of investment costs. Therefore, a centralized emission disposal facility should be established in an area with a high density of firms.

Table 8
Comparison of two sets of water treatment equipment at the Ningbo Zhonghua Paper-making Company

	Invest. 10^4 Y	Site m^2	Daily disp. amount	COD	SS	pH quota	Operational cost
Set 1	265	200	6000-7200 T	120	<30	7	0.37Y/tonne
Set 2	105.0	1000	4300 T	200	50	7	0.43Y/tonne

** Set 1: equipment made in China   Set 2: equipment acquired from the United States

5. Encouraging technological innovation

Preferential treatment in regard to taxes, loans, etc. should be given to those SMEs making technological innovations. Further, and more importantly, help should be given in order to establish information networks connecting SMEs with research institutes. Some media agencies, such as the current enviromental protection companies established by the government, should play a critical role in technological innovation and diffusion.

Environmental protection administration

1. Increased emission fee collection

The grades of emission fees should be enlarged to enhance the sensitivity of SMEs, as lots of firms prefer paying the emission fee to treating pollution.

2. Independence of the environmental protection department

The achievements of government should be adequately separated from firms' direct profits and should incorporate environmental quality. The responsibility of environmental protection should be described in detail in the government officials' examination system. Further, the environmental protection department should also be independent of government's and firms' short-term benefits.

3. Monitoring

Government should promote the establishment and improvement of environmental monitoring systems and improve the siting of monitoring spots in areas with environment pollution. The policy of "control of total pollution in one basin" should be preferred.

4. Professionals

Due to the comprehensiveness of environment protection and pollution control, the professionals in environmental protection departments either in state institutes or firms should be well trained. Furthermore, their living should be independent of the direct profits of firms' and the government's short-term achievements, to ensure their responsibility and fairness. The management and incentive pattern of environment protection professionals should be changed in line with environmental quality.

Implications for developing countries

(1) To speed up the reform in the separation of government administration and firms' operation. The government should shift its focus from making current profits to long-term development, especially sustainable development.

(2) To restructure the paper-making industry. Small paper mills should be limited and large ones should be encouraged to develop through various means to achieve economies of scale in pulp production and the treatment of pollution.

(3) To improve the level of technology. Production processes and disposal equipment should be transformed through acquisition of technology and through technological innovation.

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Introduction of the authors:

Yang Faming, Ph.D Candidate of Professor Xu Qingrui, School of Management, Zhejiang University

Wu Xiaobo, Associate Professor, School of Management, Zhejiang University, Member of IEEE.

Communication: School of Management, Zhejiang University, Hangzhou, 310027

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How to establish carrying capacities? How to implement successful carrying capacity programmes?

To find out more about these questions, read in Tourism Focus (**p. 95**) the article "Carrying capacity", by Ken Chamberlain, Former Chief Executive, Pacific Asia Travel Association (PATA).

L'industrie de la construction française et l'environnement : quelques exemples de solutions

Romain Dupuy[1], 8 Boulevard de l'Hôpital, 75005 Paris, France

Abstract
Because of the difficulties faced when preparing the issue of the Industry and Environment *review that focussed on the theme of "the building industry and the environment", UNEP suggested that I investigate this topic in France during my four-month internship. The aim was to review the daily environmental practices of the main stakeholders, based on real case studies. The positive feedback from the many people I met suggests a likely interest in the future. Unfortunately, despite a few private sector initiatives here and there, France is still at the experimental stage, whereas in other European countries integrating environmental concerns into the building industry has become a hobby horse and selling point number one. The article provides a summary of my internship report. Following a brief review of what is at stake, it intends to highlight the various notable actions taken to promote environment conservation.*

Résumé
Devant les difficultés rencontrées pour réaliser le numéro de la revue Industry and Environment *sur le thème "Construction et environnement", le Programme des Nations Unies pour l'environnement me proposa, lors d'un stage de quatre mois, d'enquêter sur le sujet en France. Le but consista à effectuer un état des lieux des pratiques quotidiennes des principaux intervenants eu égard à l'environnement à partir d'études de cas concrets. L'écho favorable retransmis par les nombreuses personnes rencontrées augure d'un probable engouement pour demain. Malheureusement, malgré quelques initiatives privées ici ou là, la France est encore au stade expérimental, à l'heure où d'autres pays européens font de l'environnement dans la construction leur principal cheval de bataille et leur argument publicitaire numéro un. Cet article, résumé de mon rapport de stage, se propose de mettre en lumière les différentes actions remarquables entreprises en faveur de la protection de l'environnement, après une brève présentation des enjeux.*

Resumen
Ante las dificultades encontradas para realizar la revista Industry and Environment*, respecto al tema "Construcción y medio ambiente", el Programa de las Naciones Unidas para el medio ambiente me propuso, durante un cursillo de cuatro meses, efectuar una encuesta al respecto en Francia. El objetivo consistia en efectuar un informe sobre las prácticas diarias de los principales actores respecto al medio ambiente a partir de estudios de casos concretos. La opinión favorable transmitida por las numerosas personas encontradas augura un probable éxito para el futuro. No obstante, a pesar de algunas iniciativas privadas aquí o allá, Francia se encuentra todavía en la etapa experimental, a la hora en que otros países europeos hacen de la preocupación por el respeto del medio ambiente en la construcción su principal lema y argumento publicitario fundamental. Este artículo, resumen de mi informe de estudio, tiene por objeto poner de relieve las diferentes acciones notables emprendidas en favor de la protección del medio ambiente, después de una breve presentación de las implicaciones futuras.*

Introduction

Le bâtiment étant le premier consommateur d'énergie en France et un générateur de déchets important, l'industrie de la construction ne peut aujourd'hui se permettre d'occulter l'Environnement. Il n'est pas nécessaire d'aller chercher bien loin pour s'apercevoir que l'isolation des bâtiments est meilleure en Allemagne et aux Pays-Bas, et qu'en France, les chantiers assourdissants sont jonchés de détritus et de polluants de toutes sortes.

En fait, les acteurs ignorèrent totalement le thème durant des décennies, jusqu'au milieu des années 70 où l'on vit poindre, peut-être en raison de la crise pétrolière, quelques germes de réflexions sur le sujet. Cela déboucha sur une première série d'expérimentations peu concluantes.

A la fin d'une seconde vague d'expériences plus volontaristes, entamées sous l'impulsion des pouvoirs publics, on constate qu'il est encore difficile de trouver des intervenants soucieux de l'environnement, en dehors d'un groupuscule particulièrement actif. Les difficultés rencontrées pour réaliser la dernière revue "Industry and Environment" sont à cet égard significatives.

Ce groupuscule d'industriels suit une politique particulièrement intéressante qui mérite d'être coordonnée, diffusée et reprise par tous.

Quelles sont les actions remarquables des maitres d'ouvrage, des concepteurs et des maitres d'oeuvre, des fabricants de matériaux, des entreprises du bâtiment ? Comment les quelques entreprises vertueuses de notre terre font-elles face à l'accroissement des coûts engendrés par la prise en compte de la qualité environnementale ? Enfin, que proposent les pouvoirs publics pour contribuer au développement durable ?

Avant de répondre à ces questions, tentons de définir les tenants et les aboutissants d'un secteur qui, un jour ou l'autre, sera contraint d'intégrer la dimension Environnement dans son travail quotidien.

L'environnement et le secteur du bâtiment

Tout d'abord, comme le souligne la **figure 1**, les atteintes potentielles qu'un bâtiment est susceptible d'infliger au cours de sa vie sur l'environnement peuvent être extrêmement variées.

De prime abord, il parait difficile de lutter à toutes les étapes (l'usage par exemple) contre tous les impacts (économies d'énergie par exemple) dans le même temps. Le lavage avant rejet des eaux usées par les fabricants de matériaux entraine une augmentation des traitements et de ce fait, un accroissement de la consommation énergétique. On parle alors d'impacts conflictuels. Il s'agit ici de trouver un parfait compromis entre des rejets aqueux peu polluants et une dépense d'énergie acceptable. Cette tâche, à la portée de tout industriel qui se respecte, se complique notoirement lorsqu'on raisonne à l'échelle de la vie d'un bâtiment. La diversité des intervenants (maitres d'ouvrage, concepteurs, fabricants de matériaux, entreprises du bâtiment, habitants...), leur faible collaboration et les connaissances restreintes en la matière constituent un frein à toutes tentatives de protection de l'environnement.

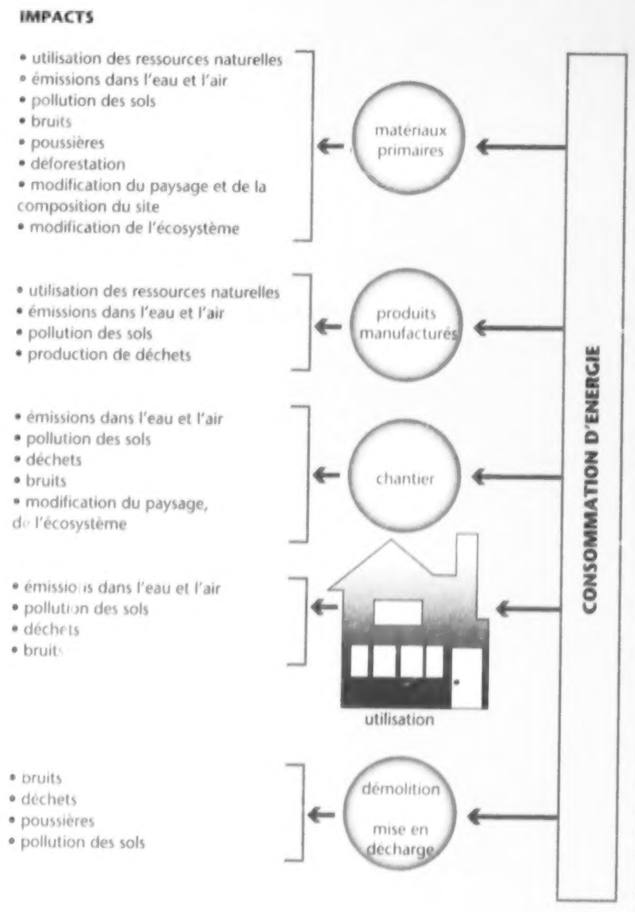
De plus, seule une amélioration de la qualité contribuera réellement au développement durable. Or, à une période où le secteur de la construction traverse une crise difficile, le moindre investissement parait aussi lourd à supporter qu'une montagne. En outre, le client ne réclame pas spécialement des habitations conçues selon une démarche environnementale et les incitations de l'Etat sont nulles.

L'ensemble de ces arguments explique mais ne disculpe pas le moins du monde les pratiques actuelles en matière de Qualité Environnementale.

Par chance, ce climat quelque peu délétère est amené à évoluer. L'environnement peut rapidement devenir un fabuleux gisement de marché. En effet, l'idée séduit le public et si les prix n'étaient pas rédhibitoires, il y a fort à parier que nous agirions en permanence pour le respect de notre biosphère.

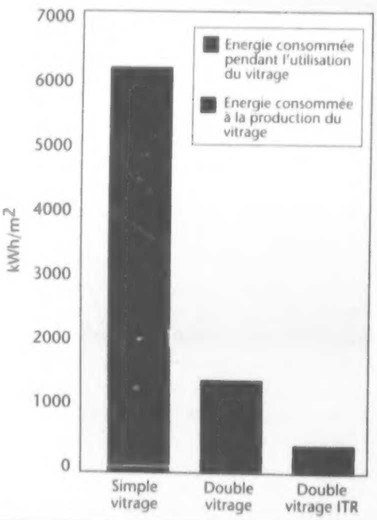
Afin de passer outre ce barrage de prix, les constructeurs vont très prochainement raisonner à une autre échelle et comparer les éventuels surcoûts finaux engendrés par la prise en compte de l'environnement. Par exemple, le double vitrage EKO+ de Saint-Gobain, pratiquement deux fois plus cher qu'un double vitrage classique, entraîne d'importantes économies à long terme. D'ailleurs, nos voisins d'Outre-Rhin l'emploie à 99 %. L'utilisation d'écrous à la place des traditionnels papillons pour serrer les banches à béton ou la location de compresseurs électriques plutôt qu'hydrauliques afin de limiter les nuisances sonores constituent des investissements négligeables, dès que la calcul est effectué à long terme (l'entreprise Pitance a même démontré lors d'une réalisation expérimentale que le changement de compresseur procure des économies à l'échelle d'un seul chantier!). La réduction des bruits n'apportera certes aucun bénéfice immédiat à l'entreprise en question, mais lui fournira un avantage certain lors de la conquête de nouveaux marchés.

Figure 1
Impacts potentiels d'un bâtiment sur l'environnement



Ainsi, quelle que soit la manière réfléchie dont on aborde le sujet, l'environnement s'avère rentable en plus d'être profitable aux générations futures.

Figure 2
Bilan énergétique des vitrages EKO+ pendant une durée de vie de 30 ans



L'incitation des pouvoirs publics

Ayant saisi l'enjeu, les pouvoirs publics entamèrent une vaste campagne d'expérimentations par l'intermédiaire du P.C.A. (Plan Construction Architecture). L'objectif consistait d'une part à sensibiliser les différents intervenants et particulièrement le maître d'ouvrage, situé à la base du projet, et d'autre part, à finaliser la démarche par le développement d'outils d'évaluations de l'impact environnemental d'un bâtiment.

C'est ainsi que 13 REX HQE (Réalisation expérimentale à Haute Qualité Environnementale) et une dizaine de REX Chantiers Verts virent le jour. Les REX HQE proposaient d'approfondir une ou deux cibles particulières comme la gestion de l'eau, l'intégration sur le site, le confort visuel, les matériaux, la santé, la qualité de l'air et le confort acoustique, à partir d'un cahier des charges comportant 13 cibles regroupées en quatre familles – Eco-gestion, Eco-construction, confort, santé. Les REX Chantiers Verts s'attachaient essentiellement à diminuer les nuisances (surtout sonores) et à gérer les déchets sur le chantier de construction. On dénombrait en plus quelques essais comme le conditionnement par projets (type salles de bains livrées en kit), le recyclage des déchets de chantier par les fournisseurs de matériaux, l'utilisation d'une huile de décoffrage végétale ou encore la mise en place de boites de réservation réutilisables permettant à la fois d'économiser du béton et de réduire l'emploi du marteau piqueur.

Ces opérations eurent l'avantage, en plus des objectifs initialement prévus, d'ouvrir des horizons et de faire tomber certains tabous. A ce titre, Spie-Citra démontra que la gestion des déchets procure des économies que l'on pourra encore augmenter par la généralisation de telles pratiques.

Profitant de cet engouement, la région Ile-de-France reprit le thème de la qualité environnementale lors de son programme Ecolycée, avant même que les conclusions des REX soient publiées, en axant son effort autour d'une programmation rigoureuse. Les résultats s'annoncent d'ores et déjà prometteurs pour un surcoût volontairement limité à 3 % de la facture totale.

A coté de ces actions de sensibilisation, les pouvoirs publics préparent des réglements et des normes en étroite collaboration avec les industriels.

A l'échelle européenne, la création du label EMAS (très proche de la récente norme ISO 14001) permet aux fabricants de matériaux, entre autres, de mettre à jour les éventuelles sources de pollution et de lutter contre les gaspillages énergétiques.

En France la réglementation existe et évolue régulièrement, mais il est regrettable que seulement quatre personnes soient chargées de contrôler le bon respect de la loi dans le secteur du bâtiment. A l'heure actuelle, la législation française en matière de déchets est bonne mais elle est en quelque sorte l'arbre qui cache la forêt. Il serait souhaitable d'aligner nos lois sur celles d'autres pays européens plus stricts.

A côté de ces mesures, que font les professionnels de la construction ?

L'action des professionnels du bâtiment

Afin d'améliorer leur image de marque auprès du public, les regroupements d'industriels ont rapidement perçu la nécessité d'intégrer l'environnement dans leurs préoccupations quotidiennes. Cependant, il n'est pas aisé de rassembler les nombreux adhérents de ces regroupements autour d'un thème considéré comme superflu par certains.

Aussi, la démarche couramment employée consiste à fédérer les membres en faveur d'un thème qui les regarde tous. La législation et les coûts sont tels que le problème de la gestion des déchets est le thème récurrent et rassembleur. L'étape suivante a pour but de sensibiliser les adhérents afin, éventuellement, de leur faire signer ultérieurement une charte ou un contrat de progrès orientant le processus dans le droit chemin. Quand tous sont enfin convaincus de la juste cause, d'autres thèmes sont introduits, tels que les problèmes de santé, de qualité de vie ou d'économies d'eau et d'énergie.

Finalement, d'éventuelles sessions de formation sont organisées et l'on assiste parfois à des concours récompensant les membres les plus attachés à la politique environnementale.

Ce schéma type, appliqué notamment par la Fédération Nationale du Bâtiment (FNB) et l'Union Nationale des Producteurs de Granulets (UNPG), est parfaitement transposable à des entités plus petites telles que les entreprises elles mêmes. Afin de regrouper les acquis de ces associations, l'Association HQE fût créée à l'initiative de Messieurs Olive, Bidou et Piron. Celle-ci se propose de rassembler les connaissances actuelles de tous, pour élaborer des plans d'action en faveur de l'amélioration de la qualité environnementale des bâtiments futurs.

1- Les fabricants de matériaux

L'extraction de matériaux de base tels que sable, gypse ou granulats a de tout temps été fort justement considérée comme polluante. C'est pourquoi, devant la pression commune du public et de la législation, une démarche particulièrement volontariste a été mise en place par ces fabricants. Aujourd'hui, les rejets de NOx des cimenteries ont atteint des niveaux plus acceptables, les carrières sont globalement réaménagées, la lutte contre le bruit fait l'objet d'une attention toute particulière, de même que le respect de l'écosystème initial.

La carrière de Sandrancourt, dans les Yvelines, exploitée par les Sablières de la Seine est un modèle du genre et permet d'apprécier les progrès réalisés depuis quelques années, **essentiellement sous la pression du public.**

Les fabricants de composants proposent ou ont proposé par exemple des *produits verts* tels que les peintures produites par Lafarge, mais la demande est si timide que ces produits végètent dans les rayons quand ils ne sont pas tout bonnement retirés du marché.

Les économies liées à l'utilisation de bons isolants étant mieux connues, les fabricants de ce type de fourniture persistent dans cette voie. Ainsi, bien que le double vitrage EKO+ soit simplement employé à 1 % en France (**figure 2**) dans les constructions neuves, Saint-Gobain, persuadé que ce verre *faible-émissivité* sera un jour le standard du marché, maintient le cap.

Concernant l'aspect production à proprement parler, signalons la démarche de l'entreprise Nicoll qui, profitant de sa mise aux normes qualités, a pu obtenir en mai 1996, pour un surcoût raisonnable, le label EMAS, lui permettant de découvrir des pollutions et dépenses d'énergies excessives, puis d'y remédier.

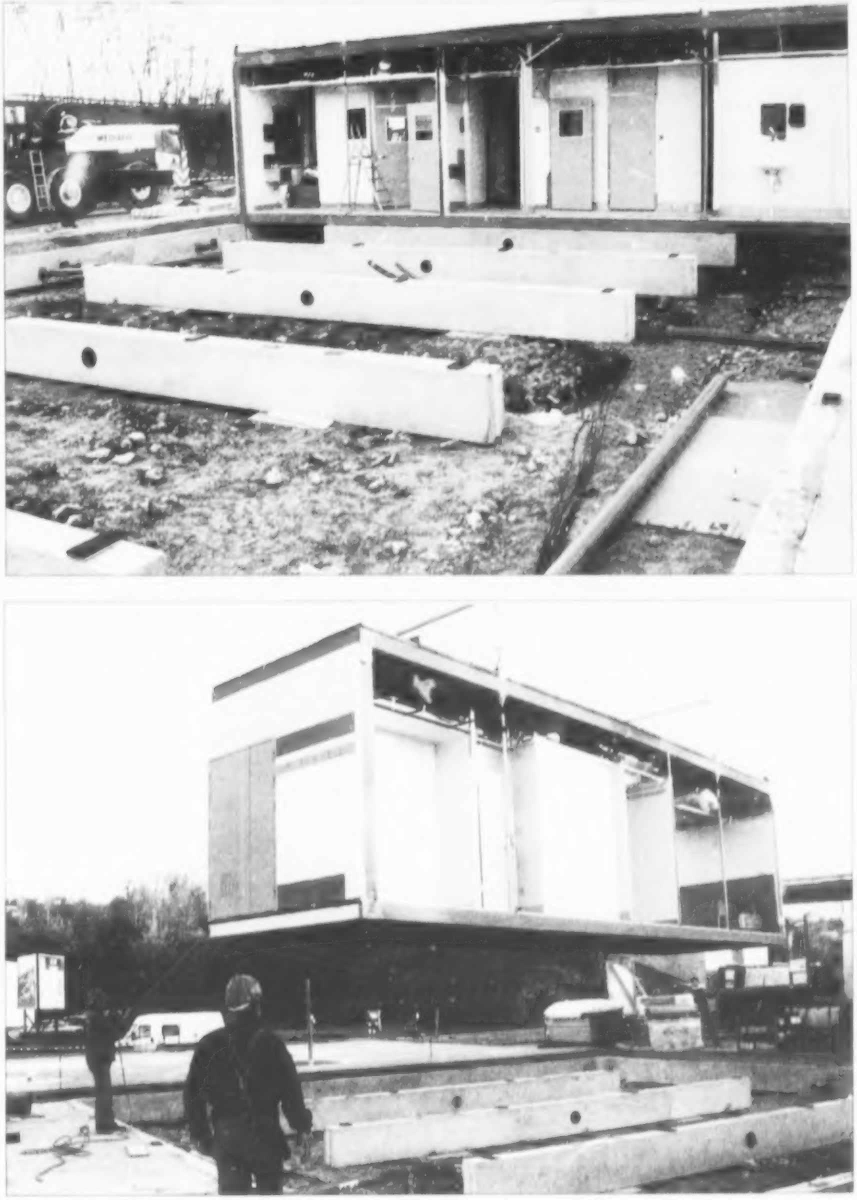


Figure 3
Modules préfabriqués McDonalds

Quand ces deux opérations sont terminées, les modules sont baches puis chargés sur des camions et acheminés sur le site. A l'aide d'une grue mobile, il ne reste plus qu'à les mettre en place.

2- Les maîtres d'ouvrage

L'amélioration de la qualité environnementale est si peu monnayable à la vente qu'il n'est pas étonnant que le maître d'ouvrage non responsable de l'usage du bâtiment passe outre le sujet.

En revanche, les aspects énergétiques et insertions dans le paysage captent régulièrement l'attention des maîtres d'ouvrage, futurs gestionnaires. Ces derniers semblent prêts à utiliser différents outils, s'ils sont simples et peu excessifs, afin de diminuer l'impact environnemental de leur construction.

La forte participation à la vague d'expérimentations du PCA laisse augurer une augmentation rapide de la prise de conscience de la maîtrise d'ouvrage publique. Côté privé, hormis quelques rares entreprises, le processus sera vraisemblablement plus lent. Parmi ces exceptions, McDonald's propose notamment un procédé de construction à l'aide de modules préfabriqués en usine (**figure 3**). De cette manière, les transports, les déchets et pollutions de chantier sont considérablement réduits, tandis que la durée de montage tombe à sept ou huit semaines.

3- Les concepteurs

Devant la difficulté de construire en étroite symbiose avec dame nature, nous assistons depuis quelques années au développement rapide d'outils d'aide à la décision, à la conception, à l'analyse du cycle de vie...

Toutefois, ces méthodes ou logiciels, conçus en général par des bureaux d'étude ou des centres de recherche, reposent en général sur une démarche pragmatique plutôt que scientifique, correspondent peu à la demande des concepteurs et, par leur coût et leur durée, souffrent d'un manque de crédibilité.

A cet égard, une recherche commune parait nécessaire pour acquérir des certitudes en la matière et développer des outils fiables, répondant aux besoins de l'architecte sur la forme du projet, et du bureau d'étude pour le choix des matériaux.

Aujourd'hui, à l'image de l'Ecologis construit dans le cadre du concours organisé à La Villette par le Comité 21, nous en sommes aux balbutiements. Certes ce type de logement prépare l'habitant à faire face aux contraintes du tri et des économies d'énergie, mais l'utilisation hétéroclite de nombreux matériaux le rend peu esthétique et sûrement peu agréable à vivre.

4- Les entreprises de construction

Sa situation proche de celle du maitre d'oeuvre confère au bâtisseur une place de choix quant à l'organisation et à la logistique des travaux. Paradoxalement, peu d'innovations sont entamées en dehors d'opérations financées par l'Etat. A l'heure actuelle, la prise en compte de l'environnement n'est pas une condition *sine qua non* pour décrocher un marché et c'est seulement sous la pression des pouvoirs publics et des clients que des progrès sont à espérer en France.

Cependant, lorsque l'entreprise reçoit des aides extérieures, elle redouble d'imagination. Le cas de Spie-Citra évoqué précédemment qui, en collaboration avec le CSTB, une école d'ingénieurs et un partenaire helvétique, fit une enquête poussée sur les déchets de chantier, est éloquent. Gageons que ces avancées seront rapidement reprises...

Aux Pays-Bas, l'entreprise Intervam, qui a dépassé ce stade expérimental, propose un intéressant système de production en série. A partir d'un modèle de base, le client est amené à choisir diverses options à caractère environnemental. Certes, ces options augmentent le prix du logement mais procurent à long terme des économies en eau, énergie, etc. Au sein d'une population entièrement acquise à la cause de l'environnement, ce type de démarche remporte un énorme succès. Dans le même temps, la production à grande échelle fait chuter les coûts, contribuant à entretenir la bonne santé de l'entreprise de construction.

Conclusion

Finalement, il est apparu que le secteur est en pleine mutation sur le plan de la protection de l'environnement. Cependant la démarche se révèle bien plus réactive que dynamique. Les professionnels de la construction ne modifieront pas leurs approches tant que la pression des pouvoirs publics et des clients ne se fera pas plus pressante.

Pour cela, l'Etat doit développer, en concertation avec tous, des lois, une réglementation, des incitations et aussi renforcer les contrôles. Cette tâche, réalisée progressivement, peut engendrer cette fameuse transformation indispensable au développement durable.

De plus, afin de réaliser cette mutation en profondeur, il parait nécessaire d'intégrer l'écologie à tous les niveaux de l'enseignement. Pourquoi ne pas insérer quelques chapitres y afférant dans la matière "instruction civique" dans le secondaire ? Pourquoi ne pas développer des modules de langues étrangères entièrement consacrés à l'environnement ou des modules plus techniques au sein des formations supérieures ? De cette manière les acteurs exigeront davantage et les dirigeants seront contraints de raisonner sur le long terme.

Avant d'en arriver là, vous, professionnels de la construction, n'attendez pas d'être poussés dans vos derniers retranchements, prenez de l'avance:

- **Maitres d'ouvrage, imposez des minima, rédigez des commandes professionnelles, poussées et exigeantes.**
- **Concepteurs, favorisez les modèles permettant de construire proprement, tout en laissant au bureau d'étude le choix des matériaux à même de protéger notre biosphère.**
- **Bureaux d'études et centres de recherche, regroupez-vous pour mettre en place des programmes internationaux de type REGENER et acquérir des connaissances plus fiables en la matière.**
- **Fabricants de matériaux, divulguez vos données.**
- **Entreprises du bâtiment, réfléchissez à la logistique du chantier et profitez des expériences réussies.**

C'est seulement à ce prix que l'on passera d'une phase d'expérimentation à une phase de protection réelle de notre planète.

---

[1] Elève à l'Ecole Nationale des Ponts et Chaussées. Stagiaire au PNUE Industrie et Environnement.

◆

New feature

Starting with this issue, Industry and Environment now includes UNEP IE's newsletters as semi-annual supplements: the **APELL Newsletter, Cleaner Production, Environmental Technology Assessment (EnTA),** and **Tourism Focus.** Two of these newsletters will appear in each subsequent issue.

THE APELL NEWSLETTER

THE NEWSLETTER OF THE UNEP IE NETWORK DEDICATED TO
AWARENESS AND PREPAREDNESS FOR EMERGENCIES AT LOCAL LEVEL

A supplement to the UNEP IE review Industry and Environment

No. 15, 1997

Provisional 1997-99 APELL Work Programme

APELL's Three Year Work Programme for the calendar years 1995-97 is being "rolled over" to cover the period 1997-99, thus taking the programme through to the end of UNEP's 1998-99 biennium.

The programme, carried out in partnership with industry and governments, continues to work in three ways: introduction of the APELL process within countries and communities; implementation and maintenance of the programme after it has been introduced; and awareness raising and training to ensure that APELL's objectives and methods continue to be clearly understood and applied. However, where the previous Work Programme set out general goals and then the associated activities and operational strategies, the new one starts by identifying the required results and goes on to identify the activities necessary to achieve them, together with timescales and performance indicators (PIs).

After eight years of APELL the role of UNEP has clearly emerged as a catalytic one. Implementation is the responsibility of agencies within the countries concerned; sometimes with the support of national and international partner organisations, including the UN Department of Humanitarian Affairs (DHA), the UN Centre for Human Settlements (Habitat) and the World Environment Centre (WEC). This Work Programme accordingly identifies wherever possible the planned activities of APELL country and international partners which will contribute to the achievement of the planned results.

As the APELL programme approaches the end of its first ten years, at the end of 1998, its overall goal is now for it to be well on its way to self-sustainability, at least in the countries where it has already been introduced, by the year 2000.

The main results sought and the main activities to achieve them are summarised below.

APELL Introduction

Results Sought by End December 1999

❑ APELL will have been introduced into at least three more countries in Asia and the Pacific and three more in Latin America and the Caribbean, and into at least one Anglophone and one Francophone country in sub-Saharan Africa.

❑ APELL will have been introduced into three Mediterranean countries via "APELL for Port Areas" projects.

❑ Computer Aided Management of Emergency Operations (CAMEO) will have been introduced as a tool for emergency awareness and preparedness in West Asia.

Activities Planned and Corresponding Resources Required

❑ Target countries for APELL introduction to be agreed with UNEP Regional Offices and contacts made through them. Achievement of these results requires the continuation of the Senior Industry Consultant secondment through the ICCA for the programme period.

❑ Venezuela will host a regional conference during 1997 to encourage government interest in Latin America.

❑ Pilot projects on risk assessment and management in port areas will be organised in Greece, Turkey and Morocco, in co-operation with the Regional Marine Pollution Response Centre for the Mediterranean Sea (REMPEC) and the Commission for the European Communities (subject to funding).

❑ APELL will also continue to be integrated into other major accident prevention and preparedness activities in Europe (e.g. by CEC, UNECE, WHO, Nordic Council, U.S. EPA) and opportunities for further APELL introduction will be taken wherever possible.

❑ Support is being sought for a regional CAMEO workshop for West Asia.

❑ UNEP IE will extend its introduction of the APELL process and programme through other UNEP activities where appropriate, e.g. some activities of the Water Unit.

❑ UNEP IE and APELL partners throughout the world will develop efforts to market the APELL programme to industry at all levels (international, regional and national), stressing APELL's "unique selling points".

❑ An approach will be made to the International Civil Defence Organisation to see if it will help promote APELL as a tool for building emergency prevention and preparedness.

APELL Implementation and Maintenance

Results Sought by End December 1999

❑ APELL will have been further consolidated, both for fixed installations and through extension to other applications (port areas, transport) in countries where it has already been introduced.

❑ More industry partnerships will have been identified and developed at all levels (international, regional, national).

❑ Aids and tools will have been produced, translated and widely disseminated to encourage the development of various types of specialised expertise necessary to implement APELL.

Activities Planned and Corresponding Resources Required

❑ UNEP will support further APELL follow-up in China; in particular UNEP ROAP will mobilise support for the development of a centre of APELL expertise in Shanghai.

❑ APELL will be extended to 45 more industrial sites in India

❑ Thailand will extend the APELL programme to two more industrial estates and will also start implementing "**TransAPELL**."

❑ National implementation plans will be developed with APELL partners in Argentina, Chile and Venezuela.

❑ UNEP IE will work with UNEP ROAP and UNEP ROLAC to determine how best to network the APELL implementation partners.

☞

UNITED NATIONS ENVIRONMENT PROGRAMME INDUSTRY AND ENVIRONMENT
THE APELL NEWSLETTER

39-43 QUAI ANDRÉ CITROEN
75739 PARIS CEDEX 15 FRANCE
TEL. : 33 (01) 44 37 14 50
FAX: 33 (01) 44 37 14 74
E-MAIL: unepie@unep.fr
http://www.unepie.org

UNEP
For Life on Earth

EDITOR:
J. Stevens

EDITORIAL BOARD:
J. Aloisi de Larderel, G. Baker,
O. El Kholy, J. Makris, A. Rojas Gutierrez

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☞ ❑UNEP IE will work with UNEP ROAP and UNEP ROLAC to reach out to industry in Asia and Latin America, particularly through the Responsible Care programme, through marketing of APELL's "unique selling points".

❑UNEP IE, with help from partners around the world, will develop the "APELL Starter Kit", including guidance on programme evaluation, to prototype stage. The prototype will be widely disseminated and its usefulness evaluated in the later part of the programme period.

❑UNEP IE will develop and disseminate the following supporting documentation:

- "Safety, Health and Environmental Management Systems: A guide for Plant Managers";
- "TransAPELL";
- APELL Local Case Studies (*see announcement in this Newsletter*);
- Internationalised "First Responders' Handbook";
- 2nd edition "International Directory of Chemical Accident Response Centres" (jointly with OECD and UNEP/DHA Joint Unit);
- Pipelines – Hazard Identification, Risk Prevention and Emergency Planning.

❑The APELL Newsletter will continue to appear twice a year in English, French and Spanish.

❑The "short list" of major industrial accidents since 1970 will be updated and information produced and disseminated on evaluation of accidents which have happened.

Awareness Raising and Training

Result Sought by End December 1999

❑"Emergency Prevention and Preparedness" will have been incorporated into the curriculum of at least one university or training institution in each country where the APELL programme has been introduced (subject to the availability of curriculum materials in the required language).

Comment

> " *Government, industry and the community have formed a strong partnership to achieve the level of success to date.....It is our programme for 1997 to complete a number of additional action items which will include a simulation exercise and finalisation of the methodology of community risk communication. The advancement of APELL in Bahia Blanca has afforded many domestic and international companies the opportunity to advance individual goals in the area of Responsible Care and specifically the CAER code in an efficient manner.* "
>
> Bahia Blanca APELL Co-ordinating Group, Argentina (see also No 13 p. 3)

Activities Planned and Corresponding Resources Required

❑Exchange of materials will take place within the Asia and the Pacific Region to assist training institutions in other countries

❑UNEP ROAP will incorporate APELL into its existing Environmental Management Systems (EMS) seminar programme for senior government policy makers and administrators.

❑An investigation will be carried out into the existing availability of training manuals and materials in Latin America and the Caribbean.

❑UNEP IE will publish, in English, "Management of Industrial Accident Prevention and Preparedness", a training resource kit for tertiary education institutions, and issue it to partner colleges in countries implementing APELL. (*See below.*)

❑UNEP IE will review and extend the material on emergency prevention and preparedness in its "Environmental Management Systems" Training Resource Kit, produced and published jointly with ICC and FIDIC.

Overall APELL Programme Review and Evaluation

Result Sought by End December 1999

❑Information will have been collected and analysed to evaluate the programme's effectiveness in preventing and preparing for accidents.

Activities Planned and Corresponding Resources Required

❑In co-operation with APELL Focal Points, try to establish how many communities in how many countries have instituted APELL programmes.

❑Try to establish how many communities have drawn up integrated emergency plans and, where possible, evaluate the effectiveness of those plans.

❑Examine indicators used within the Responsible Care programme for possible usefulness in the APELL context.

UNEP IE will organise a review meeting in mid-1998, to give guidance on programme strategy for 2000-2004, prior to organising the sixth APELL Senior Level Expert Advisory Group Meeting in late 1998.

Training in the Management of Industrial Accident Prevention and Preparedness

UNEP IE is pleased to announce the publication, in a limited edition, of "Management of Industrial Accident Prevention and Preparedness – A Training Resource Package". This is one of a UNEP IE series of trainers' resource kits on various aspects of industrial environmental management concepts and practices into the education of tomorrow's decision-makers, so that the accumulated knowledge and experience of the present generation can be passed on and enhanced.

The package is in six parts, as follows:

❻ Exercises and case studies.

UNEP IE will supply a copy free of charge to training institutions in developing countries which commit to working with the package and supplying feedback to UNEP IE for the benefit of future editions. Please note tive Staff College of India (ASCI) has developed English-language exercises based on a specially written case study, the "Hazarda Pesticide Industry", which in turn is partly derived from materials in an earlier version of the UNEP IE package. The case work contains:

- case study, with maps, plans and technical and regulatory information
- 26 work exercises, covering both technical and managerial aspects of emergencies
- back-up worksheets and diagrams

ASCI reports that this material is seen by its students as relevant to their work situations and the Indian context. It is seeking comments and advice about further development of the work.

(Contact: Dr V C Chary, ASCI, Bella Vista, Hyderabad 500049, India.)

APELL Case Studies

In the Foreword to "APELL Worldwide", published in December 1995, it was stated that: "UNEP IE intends to supplement APELL Worldwide with a further publication containing detailed case studies of APELL implementation at local level".

It has not in the end proved possible to issue APELL case studies as a separate publication, at least partly on grounds of cost. Instead, issue 20/3 of UNEP IE's quarterly *Industry and Environment* will be devoted to an examination of the current state of major accident prevention and preparedness throughout the world, including some examples of local APELL implementation. The Review last looked at this subject in issues 11/2 and 11/3 of 1988. A comparison with the 1988 material indicates considerable and encouraging progress in the intervening nine years with activities to make local awareness and preparedness a reality.

APELL Newsletter readers in non-OECD countries who would like to see these articles and who do not receive the "Review" will be able to obtain a copy free of charge on application to UNEP IE. Readers in OECD countries will be able to purchase a copy by writing to: SMI (Distribution Servies) Ltd, PO Box 119, Stevenage, Hertfordshire SG1 4TP, U.K. ***We shall confirm publication of this issue of the "Review" in a future APELL Newsletter – please do not write for copies until you have seen this confirmation.***

……

Country Reports

Malaysia

In view of the rapid increase in the number of hazardous installations, the Department of Occupational Safety and Health (DOSH) has issued the Control of Industrial Major Accident Hazards Regulations (CIMAH) 1996. These require manufacturers dealing with hazardous substances to operate their activities in a safe and healthy manner and to prepare on- and off-site emergency plans.

The Department of Environment has identified the Bukit Merah Industrial Estate in Ipoh, Perak, as the site for a pilot project to establish a co-ordinated emergency response plan. A simulated exercise will be carried out to test the plan.

(Contact: Department of Environment, Ministry of Science, Technology and the Environment, 13th Floor, Wisma Sime Darby, Jalan Raja Raut, 50662 Kuala Lumpur.)

Mexico

(See No 13 p. 3, No 10/11 p. 3 & No 7 p. 3)

The Asociacion Nacional de la Industria Quimica (ANIQ) has organised three emergency drills, in Celaya (Guanajuto), in Cosoloeacacque (Veracruz) and in Tlaxcala and Puebla. One important lesson is that governmental emergency response organisations still need more training to deal with hazardous materials emergencies and ANIQ is now trying to promote some industry sponsorship for this.

ANIQ's transport emergency centre, SETIQ, is now taking an average of 4,000 information calls and 100 emergency calls each year.

ANIQ has established its first "tank car school".

(Contact: J Montemayor Dragonne, ANIQ, Providencia No 1118, Col del Valle, Deleg. Benito Juarez, 03100 Mexico DF.)

Thailand

(See No 10/11 p. 4, No 9 pp. 3-4 & No 5, p. 3)

APELL has been disseminated within the industrial estates of Rayong, Samutprakam and Cholburi. Annual emergency response exercises were conducted for the Map Ta Phut estate on 15 July 1995 and 14 February 1996.

The Department of Industrial Works (DIW) is installing a database for hazardous chemicals management. In co-operation with other organisations it has also run training activities:

☐ three seminars on Hazardous Substances Management in Bangkok, July and September 1995;

☐ two workshops on CAMEO/ALOHA for 300 chemical firms, 17 January 1996 in Rayong and 26 January 1996 in Samuprakam.

(Contact: Helen Aromdee, DIW, Ministry of Industry, 75 Rama VI Road, Rajathevee, Bangkok 10400.)

Venezuela

(See No 13 pp. 3-4)

A group of firefighters from Puerto Cabello and Caracas have joined forces with the Venezuelan Chemical Industry Association (ASOQUIM) to produce an Emergency Response Guidebook.

Work is beginning on the establishment of a national chemical accident response centre.

(Contact: Milagro Diaz, PEQUIVEN, Apartado 61,373, Caracas.)

Books and Documents

Manual for the classification and prioritization of risks due to major accidents in process and related industries. IAEA TecDoc 727, Rev. 1. International Atomic Energy Agency (IAEA), on behalf of the Interagency Risk Management Programme of IAEA/ UNEP/ UNIDO/WHO, Vienna, November 1996.

First revision of the report originally published in December 1993, including the results of a practical case study and some new developments. Some figures have been updated but this does not mean that the results of calculations based on the original publication are no longer useful. IAEA and UNEP have co-operated on an extended print run, so that this report can now be made easily available to APELL programme users.

(Contact: IAEA, Wagramerstrasse 5, PO Box 100, A-1400 Vienna, Austria; or UNEP IE.)

The Regulation of Major Hazards in France, Germany, Finland and the Netherlands. Jones, Alan V. Health and Safety Executive, UK, 1997.

A comparative study with the aim of improving the safety of major industrial hazard installations in the context of the new Seveso II Directive (96/82 EC). Matters covered include: Who leads on major hazards?; inspection; permissioning; safety report; inspection and assessment methods; emergency planning; land use planning and information for the public.

(Contact: HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS, UK.)

RISK – Lettre Trimestrielle sur la Gestion des Risques.
Newsletter from the consulting firm Man and Safety.

(Contact: BP 3756 Douala, Cameroun.)

Related Activities

AMDA-Phil Community Disaster Preparedness and Management Project. **Association of Medical Doctors for Asia (AMDA) – Philippines and Nippon Foundation.**

This project is a response to resolutions of conferences of the International Network of NGOs in Environment and Development (INNED). It was established to address small scale emergencies in a practical manner at the community level and to promote community self-reliance and development. So far it has concentrated on natural disasters, but there are plans to move on to technological disasters. A training programme has been conducted for 40 community leaders and NGO representatives from 11 provinces and training materials in English and Tagalog have been developed for use at grass-roots level.

(Contact: Dr K Hartigan-Go, Country Director, AMDA-Philippines, Department of Pharmacology, UP College of Medicine, 547 Pedro Gil St., Ermita, Manila 1000.)

Hazard Analysis in the Chemical Industry. **24-28 February 1997, Indian Institute of Technology (IIT), Kanpur, with the participation of the Ministry of Environment and Forests.**

Course designed to teach participants how to carry out hazard analysis and how to comply with regulatory requirements. Topics

Community Based Approaches in Disaster Management (CBDM-1). **10-21 March 1997, Asian Disaster Preparedness Centre (ADPC), Bangkok, jointly with the Duryog Nivaran Network.**

First Regional Course on community issues in disaster management, providing an opportunity to share research results and successful experiences.

(Contact: Senior Manager, ADPC/AIT, PO Box 4, Klong Luang, Pathumthani 12120, Thailand.)

XI JOLASEHT – Jornadas Latinoamericanas de Seguridad e Higiene en el Trabajo. **6-10 October 1997, Santiago, Chile.**

Two-yearly conference organised by the Asociacion Latinoamericana de Seguridad e Higiene en el Trabajo (ALASEHT) concerning accident prevention, occupational safety and environmental protection in the workplace.

(Contact: Consejo Nacional de Seguridad, Calle Padre Felipe, Gomez de Vidaurre No. 1470, Casilla 1566, Chile.)

PPR '97 – Prevention, Preparedness and Response to Major Accidents – "Balancing Technology and People." **Annual Conference of the Major Industrial Accidents Council of Canada (MIACC), 28-30 October 1997, Toronto.**

psychological and social aspects; and legislation, standards and codes of practice.

(Contact: MIACC, 265 Carling Avenue, Suite 600, Ottawa, Ontario K1S 2E1; or the APELL Programme Co-ordinator, UNEP IE.)

"Productivity, Ergonomics and Safety" – International Workplace Health and Safety Forum and 33rd Ergonomics Society of Australia Conference. **24-27 November 1997, Gold Coast, Australia.**

Workplace health and safety (WHS) topics will include: risk management; integrating WHS with other management systems including quality assurance; key performance indicators for WHS; workplace communication on WHS; promoting a positive health and safety culture in organisations; and legal requirements, liabilities and associated costs.

(Contact: Conference Secretariat, PO Box 177, Red Hill, Qld 4059, Australia.)

"Safety as a Factor in Business Operation" – 9th International Symposium on Loss Prevention and Safety Promotion in the Process Industries. **4-8 May 1998, Barcelona, Spain.**

Topics include: safety as a factor in the management of business; safety in the management of operations; achievement of risk reduction; safe design or process, installation and equipment; use of programmable elec-

Cleaner Production

The Newsletter of the UNEP IE Cleaner Production Network dedicated to promoting cleaner production, the preventive environmental management strategy – applied to products, production processes, and services – that reconciles environmental protection and development.

No. 12
1997

Environmental Benchmarking and Cleaner Production

At the 1996 Fourth High Level Seminar held in Oxford 1996, "benchmarking" emerged as one of the new avenues to further promote cleaner production implementation. Gareth Martin, of the UK based ETSU, provided the following introduction to the concept and his thoughts on future applications in the cleaner production arena.

Benchmarking is a means by which an organization can measure their own performance against other similar operators, and make informed decisions on how to improve performance to meet that of the "best" performers. Benchmarking environmental performance can be an important means of encouraging the introduction and improvement of cleaner production and can be done from a national or international perspective. Recognizing resultant commercial and environmental benefits is an important step in introducing cleaner production and benchmarking can assist in this process.

Benchmarking can take many forms, but it is important to establish a meaningful measurement scale to ensure that valid comparisons are made. Benchmarking can be achieved through existing secondary information, for example through surveys. Benchmarking can consider non-technical issues such as management commitment to environmental matters or technical measures of environmental performance, such as the generation of pollutants or waste.

In the UK, Business in the Environment has developed a means of measuring a company's management commitment to tackling the environmental issues, such as the introduction and use of environmental management systems (EMS) and certification to EMS standards such as ISO 14001. This has been successfully used to rank the environmental management commitment of 73 of the top 100 companies in the UK.

The UK government's Environmental Technology Best Practice Programme (ETBPP) produces Environmental Performance Guides (EPGs) on environmental performance in industrial sectors for the benefit of UK industry and commerce. Production and environmental data on process, operation or plant is collected from a representative sample of companies using a questionnaire. EPGs are published or based on results which enable the individual companies to compare performance with that of others involved in similar operations. So far EPGs have included the use and reclamation of foundry sand, water use in the paper industry, acid and water use in metal finishing, and solvent use in dry-cleaning.

ETSU manages the technology and know-how transfer programmes and projects within the environmental field. This has included a wide range of environmental and energy programmes for the UK departments of the Environment and Trade and Industry, such as the ETBPP.

For more information, contact:

Gareth Martin – ETSU
Harwell, Oxfordshire, OX11 ORA, UK
Tel: +44 1235 432575
Fax: +44 1235 342919

UNEP IE Internet address: icpic@unep.fr
UNEP IE World Wide Web address:
http://www.unepie.org

CP and EMS: Two Inter-Related Options for Promoting Better Environmental Management

With the ISO 14001 Environmental Management Systems standard's adoption in June 1996, discussions about environmental management systems are at a high point. The Cleaner Production Programme has received an increasing number of enquiries about how EMS relates to cleaner production. Questions most often asked are "Which is better, EMS or CP?" and "How do they relate to each other?" As a response, the UNEP IE office is producing a booklet that explores the two concepts, how they are inter-related and, when appropriately used, how they can be mutually reinforcing.

dards. There is no explicit requirement within ISO 14001 to apply the cleaner production approach. Cleaner production is not specifically mentioned in the standard. A company must incorporate a "prevention of pollution" approach which is defined so broadly that it includes pollution treatment and control.

Subtly different, cleaner production is ***a strategy*** to constantly improve environmental performance by reducing pollution at source and can be applied to production processes, products or services. A cleaner production assessment is one of the key tools a company can apply to evaluate the current situation and to identify where opportunities for improvement exist. This is not the same thing as an EMS audit. Yet cleaner production can be read implicitly into the EMS requirement for continuous improvement, depending on management's understanding of this term.

Hence, in striving toward the goal of sus-

cont'd on following page

continued from previous page

tainable development, via cleaner production, an EMS can provide a framework to ensure the incorporation of cleaner production initiatives. If so desired, a company can apply for and get ISO 14001 certification, if it meets the standardized criteria. However, a need exists to ensure that by applying for EMS certification a company is certifying a system that is "preventive" approach-oriented.

It is not a question of which, cleaner production or EMS, is better than the other, and one should not become an ultimate goal to the exclusion of the other. They are both important elements, and can be mutually reinforcing ways of improving environmental performance in companies. Explaining this relationship is the ultimate purpose of the UNEP IE booklet. It will eventually be made into a training module available in the UNEP/ICC/FIDIC EMS Training Resources Kit.

For more information, contact UNEP IE.

CLEANER PRODUCTION NETWORK

The Cleaner Production Programme has identified more than 140 cleaner production centers and activities located throughout 45 countries in the world. One of the aims of the Programme in 1997 is to formalize and recognize this network as a valuable tool to help promote cleaner production. Current activities of network members will be regularly highlighted in the CP Newsletter.

Partnerships

The UNEP Cleaner Production Programme is establishing alliances with the Asian Productivity Organization (APO) to recognize their mutual interest in promoting cleaner production in the Asia-Pacific region.

APO has been actively promoting the green productivity concept in the region. Through its national affiliates, called National Productivity Organizations (NPOs), APO operates various training and demonstration programmes and an active information transfer programme.

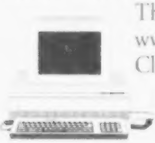
A Memorandum of Understanding (MOU) will be formulated concerning cooperation in efforts to promote sound environmental management. The two organizations will cooperate to disseminate broadly, through joint workshops and information sharing, information on experiences and results of efforts to promote cleaner production and green productivity. The MOU also formulates training and programme activities to build NPOs' capacity to provide services similar to those of NCPCs.

Similar cooperative agreement is being discussed with the World Business Council for Sustainable Development (WBCSD). In addition to the exchange of experiences and expertise, the NCPCs will form alliances with regional affiliates of the WBCSD to better develop mutually supportive programmes where potential exists.

A number of ongoing WBCSD and UNEP projects are underway. A follow-up to the booklet "Eco-Efficiency and Cleaner Production: Charting the Course to Sustainability" is underway. WBCSD and UNEP are also working together to develop a "GreenBook" training module for business school students that will be

ICPIC Update

The second version of the ICPIC diskette was made available in January 1997. There is new database of policy case studies which illustrates how different countries around the world have promoted cleaner production. The third version (based in part on the successful UNEP IE OzonAction Information Clearinghouse Diskette Version 5) is expected in October 1997. It will be available in a Windows™ format and will contain more data.



The Cleaner Production WWW page (http://www.unepie.org) highlights the activities of the Cleaner Production Programme and provides up-to-date listings of other available relevant Internet sources. Below is a sampling of the cleaner production sources listed.

ADDITIONAL WWW RESOURCES

International Organizations

- **Centre for Sustainable Design.** (http:// www.cfsd.org.uk)
- **International Institute for Sustainable Development.** (http://www.iisd.ca/linkages/).
- **United Nations Industry and Development Organization's clearinghouse** contains information on clean technology and industrial energy saving (http://www.unido.org/start/services/environment/envinfo/navigator.htmls).
- **International Register of Potentially Toxic Chemicals (IRPTC).**
- **PReventive Environmental Protection AppRoaches in Europe (PREPARE)** (http:// cleantechnology.rtc-cork.ie/PREPARE/). Activities of this European working group on cleaner production.
- **Sustainable Product Development – UNEP Working Group.** (http://unep.frw.uva.nl) The page contains information about the Working Group's programme (including LCA and Eco-design issues).

Selected National Efforts

Canada

- **Canadian Centre for Pollution Prevention** (http://c2p2@sarnia.com). This page, available in English and French, presents pollution prevention information for the North American region.

France

- **ARIST – Bourgogne** (http://bourgogne. arist.tm.fr). Cleaner Production information from the Burgundy region of France. Contains industry-specific cleaner production information. In French.
- **Office International de l'Eau.** (http:// www.oieau.fr). The page contains cleaner production databases. In French.

United States

- **Enviro$en$e** (http://wastenot.inel.gov: 80/envirosense/), maintained by the US Environmental Protection Agency contains information on cleaner production (pollution prevention) from all over the US.

Industry Initiatives

available via Internet as well as in hardcopy. It aims to educate future business decision makers on the environmental consequences of business and how best to address them.

To further this course, the CP Programme has been providing assistance to a consortium of business education institutions in India, to help integrate the cleaner production strategy into curricula on strategic management and organizational development – and ultimately the senior ranks of the Indian business community.

WHAT'S UP IN DISSEMINATING CLEANER PRODUCTION INFORMATION

Communicating with SMEs

The need to provide industry, and particularly small and medium-sized enterprises (SMEs), with cleaner production and other environmental information is widely recognized. With financial support from the European Commission, and in conjunction with the World Business Council for Sustainable Development (WBCSD), the Cleaner Production Programme initiated the project "Developing Better Information Systems for Communicating Best Environmental Practices in Business." In the first phase a meeting of experts specializing in communicating environmental information to enterprises was convened in Paris and draft recommendations were drawn up. In the second phase a draft report and survey were distributed to a wider group of experts to verify and expand on preliminary conclusions.

The final report addresses: 1) SMEs: the problems they pose and success factors for reaching them; 2) recommendations for UNEP's information dissemination effort, ICPIC; and 3) general recommendations for improving environmental information dissemination. It also contains an Appendix listing ongoing efforts directed at SMEs.

Recommendations for ICPIC improvement included:

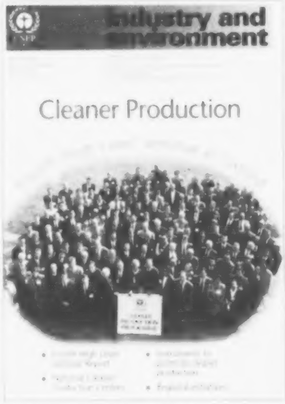
◆ Initiate an International Cleaner Production Declaration to provide a needed common framework for action on the international level, including the identification of priority information needs and dissemination mechanisms.

◆ Define and formalize the Global Cleaner Production Network by shifting focus to assisting and supporting existing and emerging national and regional level intermediaries.

For more information, contact UNEP IE.

CLEANER PRODUCTION UPDATE

Oxford Follow up



For more information, see the *Industry and Environment* review issue "Cleaner Production: Fourth High level Seminar in Oxford" available from UNEP IE.

The results of the Fourth International Cleaner Production Seminar were the focus of a special issue of the *Industry and Environment* review. The issue contains highlights from the seminar, including regional cleaner production updates and selections from the oral and written contributions to the seminar.

The conclusions of the meeting included the need to focus efforts on creating the "demand" for cleaner production. Information and assistance are now available but industry and others are not conscious of a need. Further emphasis should be put on creating demand in countries which request and receive aid, from bilateral as well as other donors. One of the other recommendations for UNEP from the seminar was to work on the drafting of an International Cleaner Production Declaration to establish an international framework for action.

The Korean Government has committed to sponsor the Fifth High Level Cleaner Production Seminar in September 1998, and initial planning is already underway. Leading up to

will provide input for the International Cleaner Production Declaration. Below are listed a number of scheduled events:

◆ 2-4 April, 1997 (Colorado, USA). US National Pollution Prevention Roundtable 1997 Conference. More than 600 pollution prevention (P2) experts, from the public and private sectors, attended policy sessions dealing with consumers, education, energy efficiency, international/ISO 14000, sustainable development, compliance, and agriculture, among other topics. For more information, contact:

National Pollution Prevention Roundtable
2000 P Street, NW, Suite 708
Washington, DC 20036
Tel: +1 202 466 6262
Fax: +1 202 466 7964
E-mail: http://es.inel.gov/nppr

Upcoming

◆ **1-3 November 1997** (Oslo, Norway). European Roundtable on Cleaner Production. (Sponsored by UNEP and OECD, with financial support form the Norwegian Pollution Control Authorities, the Research Council of Norway and the Ministry of Trade and Indus-

Tel: 47 22 86 51 07
Fax: 47 22 11 12 03
E-mail: myrj@teknologisk.no

◆ **12-14 November 1997** (Bangkok, Thailand). First Asia Pacific Roundtable on Cleaner Production. The event is held at the same time as the annual Environmental Pollution Control '97 event. Cleaner Production training is being offered before the roundtable begins for those interested. For more information contact:

Thailand Pollution Control Department
Dr Yawaree In-ma, Phahonyothin Center,
Bldg 3, 6-8, 404 Phahonyothin Road,
Phayathai, Bangkok 10400
Thailand
Tel: +662 6192215
Fax: +662 6192216
E-mail: yuwaree.I@pcd.go.th.

Similar events are under discussion for South America and Sub-Saharan Africa.

NCPC Update

Hungary joined the network of UNIDO-UNEP National Cleaner Production Centres (NCPCs) in early 1997. The newly established centre is hosted by the Budapest University of Economic Sciences. STENUM of the Graz Technical University has been selected as its counterpart institution with funding

☞ *H-1093 Budapest, Fovam ter 8. Hungary*
Tel: (36 1) 217-9588
Phone/fax: (36 1) 2188-076
E-mail: CKD_skerekes@pegasus.bke.hu

Other UNIDO-UNEP National Cleaner Production Centres are located in Brazil, China, Czech Republic, India, Mexico, Slovakia, Tanzania, Tunisia, and Zimbabwe. Negotiations are being held to establish a regional centre for cleaner production in central America.

To support the expanding network of NCPCs and affiliated institutions, UNEP established an E-mail network called NCPC-NET. NCPC-NET unites all the programme personnel, including the NCPCs, counterparts, UNIDO, UNEP, and the UNEP CP working groups via E-mail conferencing.

Encouraged by the success of NCPC-NET, UNEP also plans to establish a global network of cleaner production initiatives to complement its on-going networking activities through ICPIC, meetings, and publications.

CP Team Update

In November 1996, Kristina Elvebakken joined the CP Programme as a Junior Professional Officer seconded by the Danish government. She previously worked at the Confederation of Danish Industries as well as in a consulting company. She holds a Masters in Chemical Engineering from the Technical University of Denmark.

In March 1997 Sybren de Hoo left the CP team to take a position with a Dutch Financial institution where he will be working on incorporating environmental issues into its policies and operations.

UNEP Cleaner Production Network Contacts

Director
UNEP Regional Office for Africa (ROA)
United Nations Avenue, Gigiri
P.O. Box 47074
Nairobi, KENYA
TEL. (254 2) 521840/ 521841
FAX (254 2) 623928
E-mail: maria.deAmorim @unep.no

Mr Mark Radka
Industry Officer
UNEP Regional Office for Asia and the Pacific (ROAP)
United Nations Building, 10th Floor
Rajdamnern Avenue, Bangkok 10200, Thailand
TEL. (662) 2881679
FAX (662) 2803829
E-mail: radka.unescap@un.org

Director
UNEP Regional Office for Europe (ROE)
15 Chemin des Anémones
1219 Châtelaine
Geneva, Switzerland
TEL. (41 22) 9799111
FAX (41 22) 7973420
E-mail: Halders.@ unep.ch

Director
UNEP Regional Office for North America (RONA)
Room DC2-803,
2 United Nations Plaza
New York, N.Y. 10017
U.S.A.
TEL. (1 212) 9638138/8139
FAX (1 212) 963414/6 or 9637341
E-mail: hart@un.org

Mr Leo Heileman
Industry Officer
UNEP Regional Office for Latin America and the Caribbean (ROLAC)
Blvd de los Virreyes n° 155
Lomas Virreyes 11000, Mexico DF, Mexico
TEL. (52 5) 2026913/2024841/ 2024955/2027529
FAX (52 5) 2020950
E-mail: uneprolac@igc. apc.org

Director
UNEP Regional Office for West Asia (ROWA)
P.O. Box 10880
Manama,
State of Bahrain
TEL. (973) 276072/276073
FAX (973) 276075

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WORKING GROUPS UPDATE

Mission

The mission of the UNEP Cleaner Production Working Groups (WGs) is to identify and supply technical expertise, advice and information in support of the UNEP Programme for Sustainable Production and Consumption based on the strategy of Cleaner Production (CP) and the participation of specialized global networks.

Operating Principles

The Working Group activities are coordinated by UNEP IE.

- They operate in a co-operative and complementary manner with other CP information suppliers.
- They network within each topic area as well as amongst Working Groups to disseminate CP information to the global community.
- They provide technical and policy advice and information to industry, governments and other organizations to promote and implement CP.

Working Groups

Biotechnology
Chair: Prof. Carlos Rolz
ICAITI
Avenida La Reforma 4647, Zona 10
Apartado Postal 1552
Guatemala 01901
Tel: +502 3310631-34020
Fax: +502 3317470
E-mail: general@ns.icaiti. org.gt
Co-chair: Mr Ferd Schelleman
Institute for Applied Environmental Economics
Grote Marktstraat 24
25 11 BJ Den Haag, The Netherlands
Tel: +31 70 3464 422
Fax: +31 70 3623 469
Email: tria@knoware.nl

Textile
Chair: Dr Prasad Modak
5, Raghunath Niwas, Road No. 4, Shivaji Park
Dadar, BOMBAY-400028, India
Tel.: +91 22 416 82 17
Fax: +91 22 413 91 25
E-mail: pmodak@ giasbm01.vsnl.net.in

Food Industry
Chair: Mr Bob Pagan
The University of Queensland
Brisbane, QLD 4072, Australia
Tel.: +61 7 33651594
Fax: +61 7 33656977
E-mail: R.Pagan@ mailbox.uq.edu.au

Leather Tanning
Chair: Mr Martin van Vliet
Mr Jan-Willem Scheigrond
BLC The Leather Technology Centre
Kings Park Road, Northampton NN3 6JD, UK
Tel. +44 1604 494 131
Fax. +44 1604 648 220
E-mail: BLC@leathertech.cityscape.co.uk
Key contact:
Mr. Nick J. Cory
Leather Industries Research Laboratory
University of Cincinnati,
PO Box 21004
Cincinnati OH 45221-0014 USA
Tel.: + 1 513 556 1200
Fax: +1 513 556 2377.
E-mail: corynj@ucunix. san.uc.edu

Metal Finishing
Chair: Mr Darrell Reeve
Cleaner Production Australia
Eltham, Victoria 3095, Australia
Tel.: +61 3 94310730
Fax.: +61 3 94312821
E-mail: cpaust@linknet.au

Pulp and Paper
Chair: Prof. Allan Johansson
Technical Research Center of Finland
PO Box 205, SF-02151 ESPOO, Finland
Tel.: +358 9 4561
Fax: +358 9 460 493
E-mail: allan.johansson @vtt.fi

Sustainable Product Development (UNEP-WG-SPD)
Chair: Dr. J. C. van Weenen
UNEP-WG-SPD
Nieuwe Achtergracht 166
1018 WV Amsterdam, The Netherlands
Tel.: +31 20 525 6268/ 6237
Fax: +31 20 625 8843
E-mail: unep@unep.frw. uva.nl
WWW: http://unep.frw. uva.nl/

Education and Training
Chairs: Prof. Dr. Donald Huisingh
Oxfordlaan 25
2314 EA Leiden, The Netherlands
Tel.: +31 71 541 7257/ 4296
E-mail: Huisingh@mil.fsw.eur.nl
Mr Michael Jorgensen
Associate Professor
Building 208, DK-2800 Lyngby, Denmark
Tel.: +45 45 25 59 50
Fax: +45 45 25 59 50
E-mail: itstn@inet.uni-c.dk

Policies, Strategies and Instruments to Promote Cleaner Production
Chair: Mikael Backman and Thomas Lindhqvist
International Institute for Industrial Environmental Economics
Lund University
PO Box 196
221 00 Lund, Sweden
Tel.: +46 46 222 0200
Fax.: +46 46 222 0210
E-mail: thomasl@lu-iiiee.envecon.lu.se
Co-chair: Mr Jerry Kotas
US Department of Energy,
Golden, Colorado,
Golden National Field Office, USA
Tel.: +1 303 275 4714
Fax.: +1 303 275 4788
E-mail: kotasg@tcplink. nrel.gov

Environmental Technology Assessment

No. 5, 1997

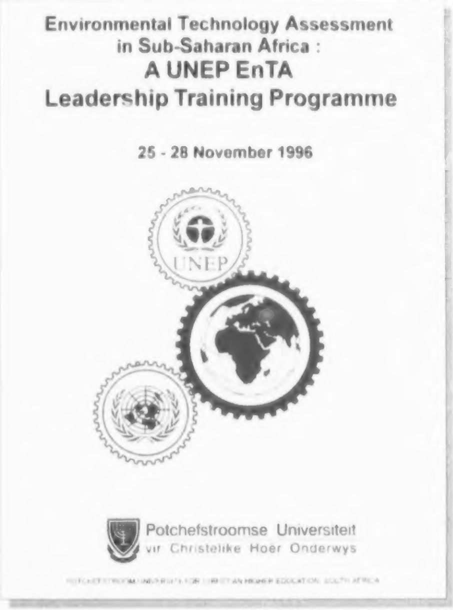
South Africa Hosts Regional UNEP Workshop on EnTA

On 25-28 November 1996, participants from African institutions and agencies met in Potchefstroom, South Africa, to learn about the practice and application of EnTA. This workshop was a collaborative effort between UNEP IETC-Osaka, UNEP IE Paris, and the Potchefstroom University for Christian Higher Education of South Africa.

The workshop focused on a range of topics, such as:

- EnTA policy and institution building in Africa;
- Interactive communication in the EnTA process;
- EnTA and gender issues/community participation;
- EnTA in the industrial sector;
- Design of national follow-up EnTA training programmes; and
- Outline of Environmental Management Systems (EMS).

The goal of the workshop was to increase awareness of the role EnTA can play in adopting appropriate technologies in the process of sustainable development. Since few developing countries systematically use evaluation tools such as EnTA, the workshop illustrated how participants could apply EnTA in their home countries.



Environmental Technology Assessment
in Sub-Saharan Africa :
A UNEP EnTA
Leadership Training Programme

25 - 28 November 1996

Potchefstroomse Universiteit
vir Christelike Hoer Onderwys

POTCHEFSTROOM UNIVERSITY FOR CHRISTIAN HIGHER EDUCATION, SOUTH AFRICA

To help catalyze the use of EnTA, participants drew up action plans. The benefit of formulating action plans in a workshop setting is that participants can draw on each others' ideas and establish local networks for cooperation on future EnTA activities. Examples of action plans included:

- report back to the appropriate organizations in order to demonstrate the importance of EnTA as an effective tool to evaluate new technologies;
- raise awareness of EnTA;
- apply EnTA to real development projects;
- maintain contact with other workshop participants on the development and exchange of ideas; and
- organize national follow-up workshops on EnTA.

These action plans will also be used by UNEP to decide where follow-up activities are needed.

Proceedings of the workshop will soon be available. For more information, contact Toru Tamura. E-mail: ttamura@unep.or.jp ■

Two sessions of the Potchefstroom Workshop were devoted to testing UNEP's recently published EnTA Primer and Workbook. Participants used selected worksheets from the EnTA Primer to identify and assess the implications of cyanide extraction of gold ore.

EnTA of corrent technologies for extraction of gold ore was chosen as gold mining is one of the major economic activities in several African countries. However several of its processes are controversial, e.g. the use of cyanide in industrial-scale minerals processing.

Participants reviewed the environmental risks of cyanide, identified alternative technology options, and examined regulatory and societal implications. Feedback from these two sessions are being applied to other EnTA training workshops such as a wastewater workshop in Wuhan, China and UNEP/UNIDO's work in small-scale mining and artisanal mining in Guyana.

If you are interested in how the EnTA Primer can be adapted to industrial applications, please contact UNEP IE via mail or E-mail: unepie@unep.fr.

INDUSTRY AND ENVIRONMENT
DIRECTOR:
Jacqueline Aloisi de Larderel
39-43 QUAI ANDRE CITROEN
75739 PARIS CEDEX 15 FRANCE

INTERNATIONAL ENVIRONMENTAL TECHNOLOGY CENTRE
DIRECTOR:
John Whitelaw
2-110 RYOKUCHI KOEN
TSURUUMI-KU
Osaka 538, JAPAN

The Application of Life Cycle Assessment (LCA) in Environmental Technology Assessment (EnTA)

EnTA can be used to assess the environmental impact of a technology at two levels – the micro and macro. At the micro level, alternatives to a particular technology are examined, e.g. alternative extraction methods to cyanide in gold processing. At the macro level, system alternatives are assessed, e.g. use of other metals in place of gold. In the micro context, Life Cycle Analysis (LCA)[1] could be used to provide important supplemental information when performing EnTA. In the article below, the authors argue that LCA is an important component in the EnTA process. The article highlights LCA's compatibility with, and contribution to, EnTA.

LCA examines all of the impacts associated with a product including the production technology in place. These include:

- the upstream impacts associated with resource extraction and the provision of services;
- the production technologies to produce the products;
- the downstream impacts associated with the use and re-use of the product; and
- the final disposal aspects.

LCA is a meaningful tool for EnTA in two ways:

- It allows for comparison of disparate technologies (e.g. the comparison of agriculture with minerals extraction) provided common system boundaries are established for the evaluation; and
- It ensures that the environmental performance of the technologies being compared is complete, and that trade-offs between various stages of the process life cycle are not ignored.

LCA is divided into four steps, which fit easily into the EnTA framework.

- 1) boundary definition;
- 2) inventory assessment (here a complete account of inputs to the process as well as outputs from the process is taken);
- 3) impact assessment (here inventories are quantitatively linked to their impacts); and
- 4) improvement analysis.

The fourth step is by far the most controversial and critical, and requires a subjective judgement to be placed on each of the technology's(ies') impacts i.e. a "preference" weighting. This weighting is influenced by social and geographical perspectives, in addition to the "harder" technical view. One way of performing this "weighting" is to use Multi-Criteria Decision Making (MCDM). MCDM determines both the negative and positive contributions of various technologies to each one of the environmental impacts highlighted in Step Three of LCA. This process identifies the trade-offs (i.e. environmental and economic) to be made when selecting one technology over another, which is a main objective of EnTA.

In conclusion, EnTA can use the LCA tool to evaluate the environmental performance of production technologies and their products from their creation to their disposal. LCA contributes to the EnTA process by providing a tool that can deal with enlarged boundaries, and therefore increases the comprehensiveness of the assessment process.

J G Petrie and M Stewart
Chemical Engineering
University of Cape Town
Rondebosch
South Africa
phone: +27 21 650 4035
fax: +27 21 689 7579
web: http://www.che.uct.ac.za/green/welcome.html

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[1] LCA analyses the environmental impact of a product from "cradle to grave". The analysis takes into account the entire life cycle of the product or function, covering all processes required: extraction and processing; manufacture, transport and distribution; use, reuse and maintenance; recycle; and final disposal. ■

Chinese Leadership Training

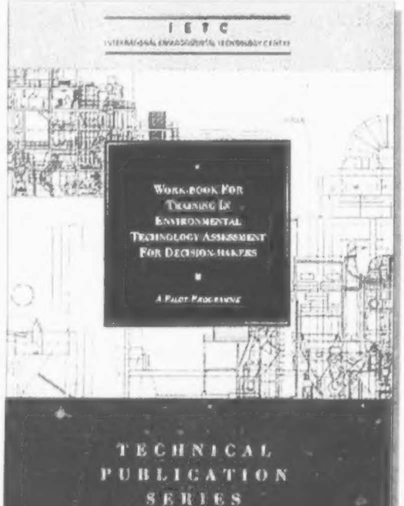
UNEP IETC, in collaboration with the UNEP/UNCHS Sustainable Cities Programme (SCP), the United States Environmental Training Institute (USETI), and the Wuhan Environmental Protection Bureau, organized a leadership training programme for China on 26-29 May, 1997. This training programme focuses on the use of EnTA in the decision-making process for the adoption of Environmentally Sound Technologies (ESTs) in the management of large cities. For more information, please contact IETC.

New Publication

Workbook for Training in Environmental Technology Assessment (EnTA) for Decision-makers

This new volume in UNEP IETC's Technical Publications Series addresses EnTA for sustainable urban and lake/reservoir management. It is based on workshop sessions and feedback from the EnTA Pilot Workshop held in Kuala Lumpur, Malaysia, in November 1995.

The *Workbook* provides information for countries which wish to conduct future EnTA training activities in urban and water manage-


I E T C
Work-book for Training in Environmental Technology Assessment for Decision-makers
A Pilot Programme
TECHNICAL PUBLICATION SERIES

adaptable to regional, national and local conditions. It can also be used to teach individuals how EnTA can be used as an analytical tool to better understand the likely impacts of a new technology on the environment. There are chapters on:

- EnTA and development issues;
- Social and scientific practice of EnTA;
- Institutional aspects of EnTA;
- Organizing regional/ national training activities on EnTA.

Also included are examples and suggestions on how to present the above-mentioned subjects. Advice is also provided to trainers who may wish to use the pilot programme in their

EST Expert Meeting

In keeping with CSD's request for further work on technology transfer, IE and IETC co-organized an EST Expert Meeting, 26-28 May 1997 in Paris. This consultative meeting focused on how to improve delivery and feedback mechanisms in currently operating information systems, particularly those systems that promote environmentally sound technologies.

The Expert Meeting built on UNEP's 1995 Expert Meeting and followed on the distribution of the final draft report, *Survey of Information Systems Related to Environmentally Sound Technologies (ESTs)*. This report surveyed international and national agencies and organizations likely to possess information on ESTs (see article below for more information). Following the distribution of the *Survey*, a number of comments were received highlighting the need for information systems to be more user-oriented. The Expert Meeting examined, and presented recommendations on, how to improve information transfer between final users and suppliers. It also built upon current collaborative work between UNEP and the European Union (EU). This EU-funded project, ("Developing Better Information Systems for Communicating Best Environmental Practices in Business") is looking at how to improve the delivery of information on best environmental practice to small and medium-sized enterprises.

A key topic the Expert Meeting addressed is how well generic environmental information systems provide information to sector-specific users. With pressure increasing to consider the environmental implications of any activity, governments, industry and business are turning to information systems for help. Currently many information systems provide information on a wide range of environmental issues and activity sectors simultaneously, for example energy use, waste and pollution in all types of industry or urban settings. What users are increasingly in need of are sector-specific information systems that focus on a particular sector, for example textiles, leather, refrigeration, or a single issue such as energy or wastewater management.

Feedback mechanisms and evaluation criteria were also central topics of the meeting. For information to reach its target audience effectively, information suppliers must have a clear idea of who their user groups are, what they need, and how their needs change. Collaborative working groups made up of users and suppliers addressed these issues and helped prepare recommendations for future action in information transfer.

Recommendations from the Expert Meeting will guide UNEP's future work on minimizing the gap between, and improving the match of, information providers and users.

For further information on the Expert Meeting, please contact UNEP IE.

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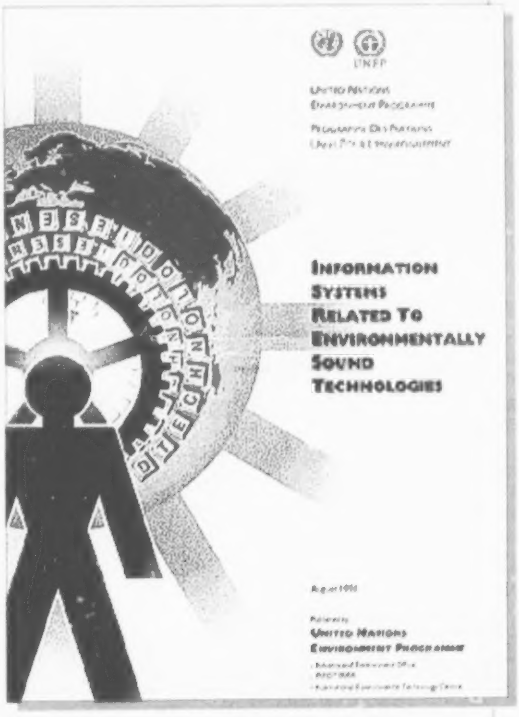
UNEP's Survey of Information Systems Related to Environmentally Sound Technologies (ESTs)

A Contribution to the Commission on Sustainable Development (CSD)



UNEP

INFORMATION
SYSTEMS
RELATED TO
ENVIRONMENTALLY
SOUND
TECHNOLOGIES

UNITED NATIONS
ENVIRONMENT PROGRAMME

This publication, *Survey of Information Systems Related to Environmentally Sound Technologies (ESTs)*, is the result of an extensive survey conducted from 1994 to 1996 on over 400 information systems and institutions likely to possess information on ESTs.

The *Survey* identifies and presents 84 information systems that have been categorized with respect to the type of information which they make available on ESTs. This "catalogue" represents a major information resource allowing the user to search for information by indices of cost, technology, dissemination method, accessibility, etc.

The publication is aimed at providing decision makers in governments, municipalities and industry with information on technologies to help mitigate environmental problems such as air and water pollution and waste management, as well as provide technological information on issues such as energy, clean production, agriculture and construction.

The publication was submitted to the fifth session of the Commission on Sustainable Development (CSD) in April 1997 to meet the critical need for a comprehensive inventory of the current state of information sources related to ESTs.

The survey is available from SMI and will also be disseminated via UNEP IETC's searchable EST Directory (see maESTro article for further infor-

This publication is available from SMI, Ltd., P.O. Box 119, Stevenage, Hertfordshire SG1 4TP, UK. Fax: 44.1438.748.844. Price: US$ 40.

maESTro Offers Technology Information

New Software launched at the 5th Session of the CSD

The UNEP International Environmental Technology Centre (IETC) launched a Searchable Information Directory on Environmentally Sound Technologies (ESTs) during the 5th Session of the Commission for Sustainable Development (CSD) (7-25 April 1997, New York). This Directory was developed by IETC in response to CSD's request to improve and increase global compatibility and cooperation among information sources related to ESTs.

Information in the Directory is collected and processed by a PC tool called maESTro. Through its Directory Interchange Format (DIF), maESTro is fully compatible with UNEP's Global Resources Information Database (GRID), NASA, CEOS, NASDA and others. As such, maESTro will provide access to a global network of EST information suppliers and users.

maESTro currently serves three databases:

(a) the IETC/IE/INFOTERRA survey on EST information systems (see *Survey* article for further information);

(b) a compilation of 130 institutions worldwide dealing with ESTs; and

(c) an overview of "hard", "soft" and indigenous eco-friendly technologies in IETC's field of activity (i.e. urban and freshwater lake and reservoir technologies).

All three sections of maESTro will be continuously updated. For this purpose, IETC is inviting technology owners and other interested institutions to add their EST information to the Directory. Assisted by maESTro, each institution can also manage its internal information collection and exchange. All entries will be accessible through a global network of EST information suppliers and users. maESTro will also be linked to UNEP IETC's homepage (http://www.unep.or.jp) for Internet browsers. For those without access to the Worldwide Web, maESTro features an automatic report function which allows printing of hard copies.

Please address your queries about, and requests for ,the maESTro software to: maESTro, UNEP IETC Shiga Office, 1091 Oroshimo-cho, Kusatsu City, Shiga 525, Japan; E-mail: maestro@unep.or.jp

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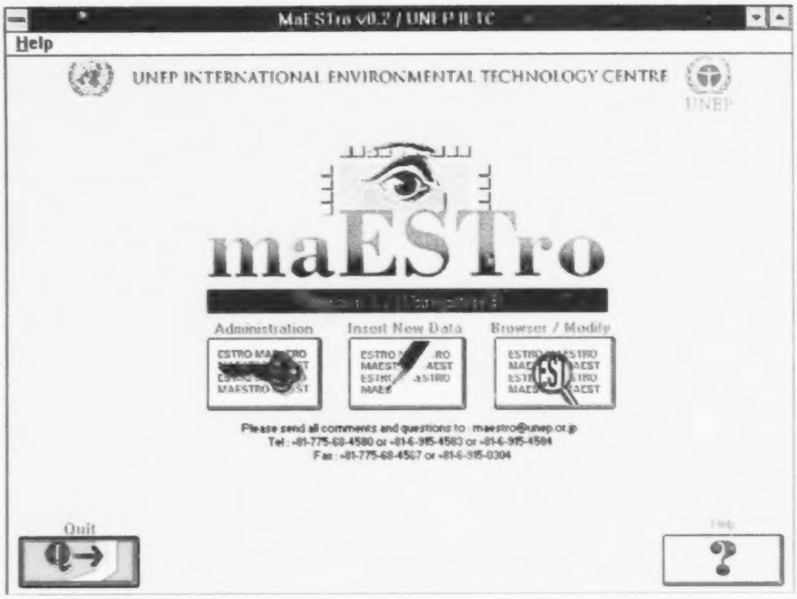

Please send all comments and questions to : maestro@unep.or.jp
Tel : +81-775-68-4580 or +81-6-915-4583 or +81-6-915-4584
Fax : +81-775-68-4587 or +81-6-915-0304

EST Yellow Pages

In an attempt to consolidate information sources and improve the exchange of EST information, UNEP IE is currently compiling a directory of equipment directories and trade fairs, *EST Yellow Pages*.

In many developing countries, one barrier to the selection of environmentally sound technologies (ESTs) is the lack of comprehensive information. This need has been answered, in part, by: UNEP's survey on information systems (see *Survey* article for more information); the publication of equipment directories by industrial organizations, publishing houses and government agencies; and trade fairs demonstrating cleaner technologies. However, decision makers are also requiring more specific information on equipment supplier names and addresses as well as technology innovations. Frequently those seeking information on ESTs are not necessarily aware of the various information sources, or do not have access to them.

The *EST Yellow Pages* is intended to narrow this information gap by providing users with a reference tool. Each entry provides a brief description of a relevant directory or trade fair, contact information and key search words. In order to keep the information as current as possible, only those directories published after 1990 will be included. Likewise, trade fairs will only be included if they occur annually or biennially.

The *Yellow Pages* will be distributed widely through various delivery mechanisms and will be available late 1997. We welcome any suggestions on directories or trade fairs that should be listed in this reference tool.

Please address your queries or suggestions to UNEP IE.

■

Information on cleaner technologies can be found on UNEP IE's two clearinghouse diskettes

The **ICPIC diskette** is a collection of databases that can help the user implement cleaner production by providing examples of technical and policy applications, abstracts of available publications, lists of expert contact institutions, and information on sources available from UNEP IE. It is a handy electronic reference tool that is easily searchable by key words and from which print-outs can be quickly produced.

UNEP IE also offers a second diskette with a wide range of information to help with the phase-out of ozone-depleting substances.

As part of its clearinghouse function under the Multilateral Fund, UNEP IE's OzonAction Programme helps to meet the information needs of government and industries in developing countries through the **OzonAction diskette** (OAIC-DV). Designed to assist with the formulation of strategies, policies and investment projects to eliminate ozone-depleting substances, this Windows™ based database system is the first step in facilitating the transfer of ozone-friendly technologies to developing countries.

For more information on these information systems, please consult UNEP IE's Web page (http://www.unepie.org) or contact UNEP IE.

Tourism Focus

A regular section reporting on developments in the field of sustainable tourism,
and on the activities of the UNEP Tourism Programme

N° 7, 1997

Carrying Capacity

Ken Chamberlain, Former Chief Executive, Pacific Asia Travel Association (PATA), 2 Ford Court, Chetnole, Sherborne, Dorset DT9 6NX, UK

Abstract

Although "carrying capacity" may have various meanings (e.g. in relation to the maximum number of people who could potentially inhabit the Earth at the same time), it is more often used to determine the level of human activity an area can accommodate without adverse effects on the resident community or on the quality of visitor experience. This article addresses the questions of how to establish carrying capacities and how to implement successful carrying capacity programmes. It is important to remember that in many countries satisfying immediate needs is a more pressing concern than planning for the future.

Résumé

Bien que l'expression "capacité limite" puisse avoir plusieurs significations (par exemple le nombre maximum de personnes qui peuvent potentiellement vivre en même temps sur la Terre), elle est le plus souvent employée pour déterminer le niveau d'activité humaine qu'une région peut supporter sans effets négatifs sur la population locale ou sur la valeur d'agrément de l'environnement. Cet article traite de la manière de déterminer les capacités limites et de mener à bien des programmes dans ce sens. Il est important de ne pas oublier que dans de nombreux pays, satisfaire les besoins immédiats est une préoccupation plus urgente que prévoir l'avenir.

Resumen

A pesar de que la "capacidad de carga" pueda tener varios significados (por ej. : en relación con el número máximo de personas que pueden habitar la Tierra al mismo tiempo), se utiliza sobre todo para determinar el nivel de actividad humana que una zona puede recibir sin ocasionar efectos nefastos en la comunidad residente o en la calidad de las experiencias de los visitantes. Este artículo aborda los asuntos relativos al modo de establecer las capacidades de carga y la manera de aplicar programas de capacidad de carga exitosos. Es importante recordar que en muchos paises el hecho de satisfacer las necesidades inmediatas preocupa mucho más que la planificación del futuro.

What is it?

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Carrying capacity is a measure of sustainability. It is:

- a practical tool to use in maintaining the balance between development and conservation;
- a threshold beyond which you should not go without further planning;
- a benchmark against which you can measure change and the causes of that change;
- an early warning system for trouble.

It is the level of human activity an area can accommodate without the area deteriorating, the resident community being adversely affected, or the quality of visitor experience declining.

The most common measures used to assess this level are numbers of people and vehicles, but they could also be the extent of logging, fishing, or other human activities. Carrying capacity is a tool that can be used in respect to both the natural and the built environment.

Why is it necessary?

While economists are saying that we are at the beginning of the fastest period of economic development the world has ever seen, the OECD and many others have said that the level of growth that has characterized the 20th century cannot be sustained. That is why "sustainable development" is so much in the news, and why measures like carrying capacity are so important.

Within the lifetime of many of those living today, it is forecast that there will be twice as many people in the world than there are now.[1] Moreover, the pressure is not just one of numbers of people but also of a rising level of per capita consumption of resources, especially within the extremely heavily populated countries of Asia.

This pressure is not just something that can be forgotten for a generation or two. The scarcity of resources is with us now. And we live in societies where growth is the measure of success. Both governments and private enterprise aim to maximize it. They are more interested in doing it now than in what might happen years from now. Governments want it before the next election. Businessmen are risk takers, and the nature of a risk taker it to identify an opportunity and seize it now while he can. Most governments and businessmen accept the idea of sustainable development in principle, but all too often principle is not translated into practice. This, again, is why tools such as carrying capacity that can help the translation process are so necessary.

Tourism as an example

Just *how* necessary can be illustrated by the tourism industry. People's desire to travel, and the number with the money to do so, continue to escalate. Both governments and the private sector want to capture as much of this market as they can. But tourism is already so big that, in many locations, it is competing for resources and finding it difficult to grow without infringing the space of other people or industries and adversely impacting the places being visited.

Many destinations have successfully attracted more tourists than they could handle and have suffered as a result. They have exceeded their carrying capacity. And what does that mean?

Environment

It means they have probably damaged their environment – overused a reef, littered a mountain trail, or fouled a beach. They exceeded environmental carrying capacity by damaging or taking from the environment at a rate greater than that at which it can restore itself.

Cultural heritage

Visitors can damage monuments and overwhelm historic buildings. They can change

UNITED NATIONS ENVIRONMENT PROGRAMME INDUSTRY AND ENVIRONMENT

39-43 QUAI ANDRÉ CITROEN
75739 PARIS CEDEX 15 FRANCE
TEL. : 33 (01) 44 37 14 50
FAX: 33 (01) 44 37 14 74
E-MAIL : unepie@unep.fr
http://www.unepie.org

UNEP
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DIRECTOR:
J. Aloisi de Larderel

EDITORS:
Hélene Genot
Oshani Perera

the pace and the traditional way of life of a popular destination. Too many visitors may have destroyed the "sense of place" that was the main reason people were attracted to the area.

Residents

It means that those who do not directly benefit from the tourists are unhappy. They do not like to be pushed aside by visitors and to have to put up with the traffic, rising prices and change that tourism is bringing to the community. The frequent result is the rise of strong opposition within the community to further tourism development.

Quality of the visitor experience

Too much tourism implies crowds, congestion, delays and high prices, slow service, cold food, and so on. People are unable to rest and relax at the resort or to enjoy the serenity of nature and the ambiance of a great monument. Worst of all, they will not want to come back and will tell their friends what they think of the place.

So how can these problems be solved? You have to have some measures that can warn you when these kinds of impacts are starting to be felt. That means you must have gone through the process of establishing a carrying capacity programme.

Why is this not being done?

With the emphasis that is being placed on the environment in the 1990s, the doors are no longer closed to the concept of sustainable development. It is, in fact, good politics to support it. Agreements are reached and plans are developed that attest to the importance of carrying capacity. It is still rare, however, to find a carrying capacity programme in operation. Why is this? The reasons are many. They include:

- a belief that the concept of carrying capacity is an academic exercise that is too complicated and a waste of time;
- the overriding pressure on governments for economic development and, in particular, for job creation;
- the adoption of travel and tourism as the growth industry that can relieve this pressure quickest, and the emphasis on promoting this industry;
- the competitive pressure on the private sector and the tendency, in many cases, for the outlook to be short-term;
- entrenched interests that resist restraints on growth, including traditionalists who fight restrictions on principle;
- an unwillingness to accept the need for sustainable development.

What can we do about this?

1. Make it simple

There are those who have made the establishment of carrying capacity a matter of higher mathematics. Instead, it is a simple matter of judgment. If you forget higher mathematics and the latest research techniques and simply use the best judgment of the people on the spot, carrying capacity can be established easily, quickly, and with limited expense. It is far more important to establish the benchmark than to worry about whether or not it is 100 per cent accurate. The situation is changing in any case, and the carrying capacity should be adjusted according to actual experience. The key therefore is not to be put off by complicated formulae, and instead to keep it simple and go ahead and make a decision on the carrying capacities needed.

2. The process

Assemble a small group of people, preferably not more that seven or so in number, who are qualified to make the judgments required and are representative of those with a stake in the area. The size and make-up of the group will vary from place to place. It may include some who work full-time in the area, representatives of tourism and of other industries operating in relation to and within tourism, representatives of the residents, and, where possible, someone with conservation experience. The group could be chaired and briefed by a local government official. It is recommended that there be an experienced outside facilitator to guide the discussion, respond to questions, and ensure that the goals of the meeting are met.

More than one meeting may be needed when capacities, measurement criteria and implementation plans are first established. Subsequently the group could meet at agreed intervals, such as once a quarter, to review actual experience and adjust carrying capacities accordingly. Monitoring and feedback should therefore be an ongoing activity.

3. Items to be considered

In general terms, the key elements are:

- the protection of the area's environment;
- impacts on the resident or local community;
- the quality of the visitor experience and of business operations in the area.

When a carrying capacity is established, focus is placed on the places or times where usage is the heaviest or where the damage or other problems are of greatest concern. Specific consideration should be given to:

- variations by season, day of the week, and hour of the day;
- the pressure on some locations within the area being greater than elsewhere, due to the volume or length of usage, the fact that space may be confined, or the location itself being physically fragile;
- the degree to which residents and other users of the area are disturbed, or other identified social impacts;
- observed environmental deterioration, etc.;
- stress on services such as water supply, power, sewage, etc.;
- safety;

plus other items specific to the situation concerned.

4. Quantitative and qualitative measures

These should be established on the basis of the judgment of the group and used to assist in monitoring the above mentioned items. They also should be adjusted according to experience.

In addition to the agreed carrying capacity for the area, this will usually involve developing:

- carrying capacities for spots within the area that are the most used, space restricted or fragile;
- a threshold level for complaints from residents, visitors, operators and staff, both overall and by major category;
- a record of breakdowns in services being offered;
- indicators to be used in assessing environmental damage;
- a threshold for the scale of business operations in the area;
- the maximum desired capacity of facilities such as car parks, lodging and eating facilities inside and adjacent to the area.

5. Management

Except in a limited number of areas such as national parks and reserves, growth is not being effectively managed. Even in national parks and reserves, the degree to which carrying capacity programmes are operating varies greatly. The following attributes are important to improving growth management and introducing an effective carrying capacity programme:

A single management authority

National parks and areas like the Australian Great Barrier Reef have such an authority. No development should take place within the area's boundaries without its permission.

Involvement

All stakeholders should be involved in the managing authority's decision-making process.

Controls

These could include gates, permits or licenses to operate or construct in the area, etc.

Guidelines

In consideration of the interest of others, and for environmental protection, there should be guidelines for everyone in the area to follow.

Enforcement

If sustainable development is to be taken seriously and carrying capacity programmes introduced, the above controls must be consistently enforced and the guidelines monitored.

Conflict resolution.

Whenever a programme of restraints is introduced, there are likely to be conflicts. For the programme to be effective, it is important that there be an atmosphere of conflict resolution, not confrontation. In this way, opposing views can be not just heard but also understood. Areas of agreement can be developed and the basis laid for further cooperation.

6. Awareness creation

Information

Programmes that restrict can be disastrous if the reasons for them are not clearly explained to those affected. Concise explanations should be provided whenever a company, organization or individual is restricted by the carrying capacity programme. These explanations should be given as to the rationale in respect to both the overall programme and the particular control or guideline concerned. Information on the programme and the rationale for its contents should also be circulated to wider government, business and consumer publics.

Economic arguments

There is almost nothing like the loss of business to make a businessman think again. Similarly, government will start to take notice if its revenue begins to fall. Income-oriented arguments are therefore strongest when they seek to convince these audiences that carrying capacity programmes and the management discipline they require are necessary. Both demand and supply arguments can be used.

Demand

Preference for items produced in an environmentally friendly manner, and for travel to destinations with effective environmental protection programmes, is increasingly strong in OECD countries and in some countries outside this group.[2] In a growing number of cases, the feeling is becoming one of active opposition to countries that do not measure up in these respects. Countries and companies with sustainable development programmes, such as carrying capacity programmes, therefore have an advantage. This is a powerful business argument to use in support of carrying capacity programmes.

Supply

Without the restraints that the application of carrying capacity can provide, the resources of an area can be over[illegible] there is too much extraction, logging or fishing, for instance, the supply of product is reduced and a limit is placed on the life of that industry in the area. In regard to tourism, when there are too many people the attractiveness of a place tends to decrease and visitors tend to go elsewhere. In both cases, business will decline if no corrective action is taken.

Conclusion

If the concept of carrying capacity is to be understood, accepted and implemented, it is important that all parties be convinced that conservation is part of development and not its enemy. Confrontation should be replaced by conflict resolution, on the conservation side as well as on that of development.

It should be realized that many countries have very different priorities to those that have come to the fore in the developed world during the 1990s. Planning for what may happen many years ahead is not high on their list. Their needs may be much more immediate: food, shelter and security. If differences are to be resolved, allowance must be made for this.

The overall conclusion, however, is that it is important to pursue sustainable development wherever and whenever we can, and that the introduction of carrying capacity programmes is a vital part of doing so.

Ken Chamberlain's telephone/fax number in the UK is +(44.1935) 873.282.

References

1. See, for example, a review of some recent books on the subject (*How Many People Can the Earth Support?* by Joel E. Cohen and *The Carrying Capacity Briefing Book* by the Carrying Capacity Network, Washington, D.C.) by Bill McKibben in the *New York Review of Books*, 29 May 1997.

2. As of mid 1997, the Organisation for Economic Co-operation and Development (OECD) has 29 members: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

◆

Calvià, Mallorca: report on a Local Agenda 21

Margarita Nájer, Mayoress of Calvià, Ayuntamiento de Calvia, C/Can Vich 29, Calbia, Bale 07184, Balearic Islands, Spain

Abstract

Calvià's "local Agenda 21" is a response to decades of growth and intensive occupation of this mass tourism centre on the Mediterranean island of Mallorca. Its aims are: quality tourism year-round (not just seasonally), environmental management of facilities, including refurbishment and modernization, the well-being of future generations of residents, and participation by all social sectors in achieving these goals. A number of specific actions have already been taken.

Résumé

Le programme "Action 21 local" de Calvià est la réponse à des décennies de croissance et d'occupation intensive de ce centre touristique très fréquenté de l'île de Majorque. Il a pour objectifs un tourisme de qualité tout au long de l'année (pas uniquement en saison), la gestion des installations du point de vue de l'environnement, notamment leur rénovation et leur modernisation, et la mobilisation de tous les secteurs de la société pour atteindre ces objectifs. Plusieurs mesures spécifiques ont déjà été prises.

Resumen

La "Agenda Local 21" de Calvia es una respuesta a las décadas de ocupación intensa y crecimiento de este centro de turismo de masas en la isla mediterránea de Mallorca. Sus objetivos son : turismo de calidad todo el año (no solo por la temporada), dirección medioambiental de las instalaciones, incluso modernización y restauración, el bienestar de las generaciones futuras de residentes y la participación de todos los sectores sociales en el logro de tales objetivos. Ya se han llevado a cabo cierto número de acciones al respecto.

Why a Local Agenda 21?

Calvià, on the Spanish island of Mallorca is a typical first-generation Mediterranean mass tourism centre of the "sun and beach" type. Calvià has 30,000 inhabitants and an area of 145 sq km. Each year it is visited by 1,200,000 tourists. Calvià has the capacity to accommodate 120,000 visitors.

After 30 years of growth and intensive occupation of the coastal area, Calvià is on the verge of a situation which could well endanger our own welfare and that of future generations. In 1994, the Town Council faced the dilemma of continuing along the road begun during this period of economic growth or designing a future for Calvià based on sustainable development. Hence, "Calvià, Local Agenda 21" came about. It has the following aims:

◆ **quality tourism**: adapting the tourism offered to the new market preferences for environmentally-conscious tourism, and avoiding overcrowding;

◆ **the environment**: protecting natural parks and preserving rural, forest and coastal areas in order to put a stop to the process of urbanization;

◆ **refurbishment and modernization**: reconverting existing tourism facilities, as an alternative to the construction of new buildings;

◆ **breaking away from seasonal swings**: introducing initiatives so that in the future Calvià has a quality tourism industry all year round;

◆ **the young**: guaranteeing well-being for future generations of Calvià residents;

☞

Above, new boulevard of Pegueia with solar-powered street lighting.

Left, demolition of derelict tourism facilities.

- **participation:** encouraging all social sectors to participate in the process, as a fundamental part of achieving these objectives.

How we worked

First phase: drawing up of the first document on the philosophy to follow and the procedures required to successfully introduce it. This phase has been completed.

Second phase: drawing up of a draft plan on the basis of the selection of Key Thematic Areas (KTA): 1) environment, 2) local attractions and quality of life, 3) urban planning system, 4) culture and development, 5) economic structure, population and institutional organization. Each subject area is being covered by working groups of more than 30 professionals and experts in their respective fields of work, who are working on indicators to analyse three scenarios for the year 2025: the "future" scenario, the "tendential" scenario, and the "desirable" one. Consideration is given to which plans should be applied in order to realize the desirable scenario. This phase is presently being carried out.

Third phase: finalization of the project, at which time the recommendations, plans and regulations for private activities, and the diffusion and support of the five "Rs" (Reduce, Recover, Return, Reuse and Recycle) will be implemented. At the present time, groups of citizens are being organized to collaborate in some of the areas in which they are interested.

What bodies does the organization have?

The Town Council Management Committee coordinates all municipal actions with private ones and with those of other institutions. The External Assessment Forum is the main way for citizens to participate in the town's affairs. It is made up of those who are interested in Calvià's sustainable development.

Key Thematic Areas (KTA) are established by council technicians and independent professionals who are experts in their own fields of study (the environment, local attractions and quality of life, urban planning, culture and development, economic structure, population and institutional organization).

Institutional support committees are made up of people who sympathize with the project, which they advocate to institutions and citizens' groups.

What specific actions have been performed?

The General Plan for the Town Planning By-laws has been modified, which means that 1,500 hectares of building land has been reclassified and all new building projects will be subject to the philosophy contained in the "Local Agenda 21".

Recovery of landscape, public areas and green zones has already begun with the demolishing of obsolete hotel and tourism facilities as a result of both private and public initiatives.

The installation of a double water supply system will begin, with recycled water being used to water public and private gardens, fill toilet cisterns, etc.

An agreement has been signed between the Ministry for Public Works, the Balearic Islands Government, and the Town Council so that Calvià will become a pilot experiment of the European Union programme for "Integrated Management of Coastal Areas".

Investments have been made in the installation of renewable and non-polluting energy sources. All new residential and commercial establishments in Calvia now have to follow eco-design specifications which include solar panels, energy and water conservation measures, and provisions for waste separation and recycling.

The Environmental Education Campaign for Calvià's schoolchildren and students has been launched. Every year, during the "environmental week", themed education packs for students and teaching are published and field excursions are organized. "Know your Coast" was the 1996 theme, and "Know What is Under the Sea" is the one for 1997.

In April 1997, the International Conference on Tourism and Sustainable Development in the Mediterranean took place in Calvià. Around 500 experts from 28 Mediterranean Countries exchanged experiences and approved the Calvià Declaration, which stresses the important role of local authorities in leading and coordinating action for sustainable tourism.

What are our future plans?

The Calvià Walkway, a 35 km urban road, will become a pedestrian, cycling and low-speed traffic road where the pedestrian has priority, with the aim of connecting the residential areas.

A referendum will be held in which the residents of Calvià will participate, in order to determine the town's future development.

A training meeting for civil servants and politicians of local and regional authorities will take place in March 1998 on "Tourism and Sustainable Development in the Mediterranean".

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World News

A sustainable business challenge to students from WBCSD

At a press conference on 18 April 1997, the World Business Council for Sustainable Development (WBCSD) announced that students preparing for careers in business, finance and government will soon be able to test their knowledge of environmental issues by taking a three-hour exam on the Internet. The multiple-choice format exam has been developed by the Foundation for Business and Sustainable Development and will be available on Internet from 5 June 1997 onwards. The background to the exam initiative was a study by MIT which showed that many business students do not consider environment courses as relevant to their studies or career paths, and that they often do not even dare to refer to such things for fear of being perceived as possible troublemakers by potential employers.

This contradicts the declared intentions of the WBCSD, which is committed to being the leading business advocate on environmental issues. It was therefore decided to launch the exam initiative with the Association internationale des étudiants en science économique et commerciale (AIESEC). This is the largest student organization in the world, represented in 740 universities in 75 countries, with 100,000 active members and an outreach to nearly 1 million students. Successful candidates will be awarded a WBCSD certificate and will receive a letter of introduction from its chairman to the 120 member companies. To avoid less developed countries being marginalized by the exam content, a study is underway to identify the issues most relevant to sustainable development in different cultures. For those areas of the world where there is no connection to the Internet, the exam will be available in pamphlet form.

Students intending to take the exam will be helped in their preparation by the *Green Book*, a publication prepared by the WBCSD with input and comment from the United Nations Environment Programme (UNEP) which presents the key sustainable development issues currently being addressed by the international business community and United Nations. The *Green Book* is aimed at new graduates from business schools. However, to further efforts to produce environmentally literate decision makers, UNEP and the WBCSD are also working together to adapt the *Green Book* to make it suitable for engineers. The WBCSD, the World Federation of Engineering Organizations and UNEP are also planning a conference in Paris in September 1997 on how environmental issues can be integrated into the curricula of engineering institutions to produce environmentally literate engineers.

Further information and the exam paper can be found on the WBCSD Web site: www.wbcsd.ch/foundation

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Country profile – Bulgaria

The Republic of Bulgaria extends from the western shore of the Black Sea to the former Yugoslavia in the west and Romania in the north. The major part of its northern border is formed by the Danube; Greece and Turkey lie to the south and south-east.

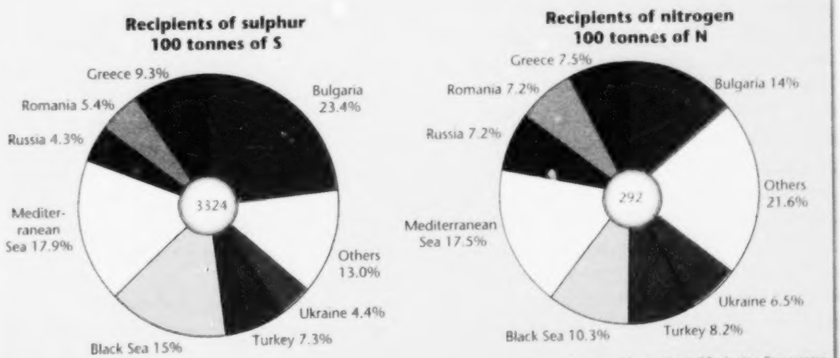
During the years between World War II and 1989, the country's economy was fully state-controlled. Bulgaria was transformed during that period from a largely agricultural country to an industrial one. In 1989, in-depth political change had profound repercussions on the economy and disrupted relations with the Comecon countries, resulting in a 14 per cent decline in GDP between 1990 and 1992. Inflation peaked at 254 per cent in 1991, stabilizing at around 75 per cent in 1992 and 1993.

The fall in economic output which followed the political and economic upheaval, especially after 1990, resulted in a significant decrease in emissions of key pollutants such as sulphur oxides (SO_x), nitrogen oxides (NO_x) and carbon dioxide (CO_2). Nevertheless, high levels of pollution from a variety of sources still persist in Bulgaria and are contributing to extensive environmental damage. Pollution of air and water, and waste management have been identified as areas for priority action.

The environmental legislative framework

Following elections in 1990, Bulgaria's communist administration was replaced by a parliamentary democracy. Legislative and executive powers were centralized and now lie with the National Assembly and Council of Ministers. Environmental policy is therefore decided by the central government. The most important institution in this respect is the Ministry of Environment, formed in 1990, which operates under the control of the Council of Ministers. Its major functions are to: draft environmental legislation; coordinate environmental protection and pollution control; monitor the state of the environment and compliance with legislation; enforce environmental legislation; implement measures to protect biodiversity and manage protected areas; coordinate and implement international agreements and cooperation in the field of environment; manage the National Environmental Protection Fund and control use of Municipal Environmental Protection Funds; issue permits for water discharges; and supervise environmental impact assessments jointly with relevant ministries. The ministry has 16 Regional Environmental Inspectorates which assist it in enforcing environmental laws, preparing environmental improvement programmes, and informing the public about the state of the environment; 780 people were employed in environmental administration in 1995 including 136 in the Ministry of Environment and 520 in the Regional Inspectorates. Under the new parliamentary regime, municipalities have also been empowered to develop environmental protection programmes in collaboration with the Ministry of Environment or

Figure 1
Deposition of Bulgarian SO_x and NO_x emissions, 1993



Source: European Monitoring and Evaluation Programme with the Ministries of Health or Agriculture and Food.

Basic legislation on environmental issues has been in place in Bulgaria since the 1960's, developed under the auspices of the then Ministry of Forests. However, although stringent ambient environmental quality standards were defined, no practical means were provided for their enforcement. Only a general obligation was placed on industry to meet emission limits. No deadlines were set for compliance, and the absence of any permit system meant that no plant-specific requirements were imposed. As a consequence, legislative targets were rarely reached.

Environmental issues became a matter of serious public concern in 1990, when non-governmental organizations objected to several projects. The resulting actions led to the suspension of building of a nuclear power station, suspension of a dam project, and the closure of uranium mines. In 1991, the National Assembly passed an Environmental Protection Law which provided a new foundation for Bulgaria's environmental policy. This law, adhering to the polluter pays principle, set up a system for the implementation of environmental policy and fixed objectives, including: application of environmental impact assessment; introduction of charges for use of natural resources; establishment of the National Environmental Protection Fund and Municipal Environmental Protection Funds; provision for citizens' suits; and provision for right of access to information on the state of the environment. In 1992, the Ministry of Environment adopted an Environmental Strategy, developed with the assistance of the World Bank and the US Government, identifying priority areas for policy reform and action. This strategy was updated in 1994 with additional areas for priority action.

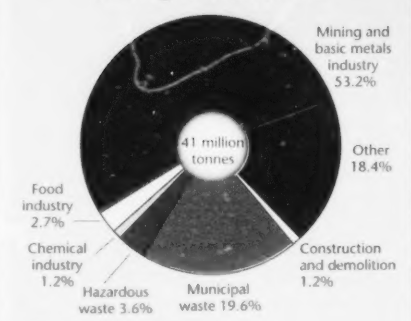
Air pollution

The Ministry of Environment's 1992 Environment Strategy identified air pollution as a threat to human health and a priority for action

Bulgaria's industry, predominated by metallurgy, chemicals, oil refining and pulp and paper manufacturing, is a major source of air pollution. By and large it uses old technology, has ageing production equipment, and is characterized by low efficiency in use of energy and raw materials, and by outdated and highly polluting technology. The concentration of large plants in separate industrial areas has created pollution "hot spots" where emissions from large industrial plants pose a direct serious threat to human health. The 1994 Environmental Strategy Update identified nine main air pollution hot spots including lead, zinc and copper smelters, and iron and steel production plants emitting high levels of particulates containing heavy metals; chemical plants emitting high levels of volatile organic compounds (VOC); and cement plants emitting particulates.

Energy production is also an important source of air pollution. Bulgaria is poorly endowed with mineral resources and, in particular, the country's lignite, used in public thermal power plants, has one of the world's lowest calorific values and contains a high percentage of ash and sulphur. These power plants are the main source of sulphur oxide emissions, accounting for 80 per cent of the national total in 1993. In that same year public power plants also generated 42 per cent of particulate emissions, 28 per cent of emissions of nitrogen oxides and 31 per cent of CO_2 emissions. The plants are relatively old, dating from the 1950's and early 1960's, and often the only form of emission control is inefficient particulate collectors.

Figure 2
Waste generation, 1992



Source: Ministry of Environment

The transport sector is also a major contributor to air pollution, producing 45 per cent of NO_x emissions, 35 per cent of CO and 30 per cent of non-methane VOCs in 1993. Ageing and poorly maintained buses and heavy goods vehicles are the main sources of these forms of air pollution, and the situation is aggravated by the fact that most cars are over ten years old and more than 7 per cent of them have two-stroke engines emitting high amounts of particulates and hydrocarbons.

Transboundary air pollution from SO_x and NO_x emissions is significant in Bulgaria, as illustrated in **Figure 1**. Over half the emissions of nitrogen and sulphur are deposited in other countries, and about 15 per cent fall into the Black Sea. Conversely, the majority of nitrogen and sulphur acid deposition in Bulgaria originates from SO_x and NO_x emissions in other European countries. Bulgaria is a signatory to several international agreements and protocols in which countries pledge to restrict or cut their emissions to alleviate this problem.

Priority environmental actions defined in the 1992 Environmental Strategy included: revision of existing ambient air standards to more attainable levels; development of information standards for acid deposition; setting of emission limits for motor vehicles; development of local air management plans for highly polluted areas, including specific measures to reduce pollution levels; increase in air pollution fines to dissuasive levels; improvements in air quality monitoring; reductions in energy subsidies; and curtailing of retail distribution of high-sulphur coal in highly polluted areas.

Water management and pollution

The latest available data (1993) indicate total freshwater abstraction of 3.4 billion cubic metres. Drinking water quality is generally good, although prolonged drought, serious leakage in distribution systems, and high consumption by industry have caused chronic shortages in recent years. Some 60 to 65 per cent of the population is under some form of water restriction. There are also one or two isolated areas of concern over pollution by heavy metals from industrial plants. Industry is a major water user and there are 4,450 large enterprises registered as discharging effluent. Of these, 2,433 are listed as having some form of treatment plant and 712 as requiring treatment systems. The recent decline in industrial activity is reflected in improved water quality in several river basins.

Municipal waste water is another major source of water pollution. In 1993, only 35 per cent of the population was connected to a waste water treatment system, and of 97 towns with more than 10,000 inhabitants, only 24 have sewage treatment plants. Twenty-nine other towns are building facilities.

Animal husbandry and excessive use of fertilizers have contributed to water pollution by sulphates and nitrates, although levels have dropped in recent years. Fertilizers were applied most heavily during the early and mid 1980's, when they caused groundwater pollution. Rising fertilizer prices caused this to tail off, with a sharp drop after 1989. The number of animal feed lots has also fallen rapidly. Large pig farms, the main source of pollution, have gone from more than 400 in 1994 to around 100 at present. Forty of these now have effluent treatment systems.

The Ministry of Environment is responsible for water quality management and monitoring, while the Ministry of Health sets drinking water standards and the Ministry of Regional Development and Construction builds and manages water supply systems, municipal treatment plants and collection systems.

A waste water permit system exists, under which individual facilities negotiate with the Regional Environmental Inspectorates. However, as discharges are required to meet unrealistically high standards, enforcement is ineffectual. Many industries lack adequate pre-treatment facilities and discharge their effluent directly into the municipal sewers.

The Ministry of Environment is developing a new permit system which will introduce waste water standards harmonized with those of the European Union (EU). As implementation may take as much as ten years, interim standards are to be introduced.

The Regional Inspectorates already impose fines for industrial discharges exceeding effluent quality standards. The levels of fines are based on the substances discharged, the concentration, and the volume of the discharge. Rates have risen by as much as ten times in the last five years.

The Ministry of Environment has also drafted a comprehensive water law which, if enacted, would establish the framework for integrated and sustainable management of water supply and treatment.

Waste management

Excluding waste from energy production and agriculture, 41 million tonnes of waste were produced in Bulgaria in 1992. **Figure 2** shows the general breakdown of waste generation for that year. Reliable data on trends since then are scarce, as there is a general lack of proper classification and statistics.

Mining and basic metal production generated 22 million tonnes of waste in 1992. This stems from the very high use of raw materials, especially low-quality coal and ores with low metal content, reflecting an economy still oriented towards heavy industry and relatively inefficient in its use of materials. Domestic Bulgarian lignite and brown coal produce between 15 and 20 per cent of their own weight in ash when burnt. The chemical industry produces low quantities of waste. However, this often contains hazardous substances.

Large landfills are located next to major industrial plants which often store their own waste on site. These on-site industrial landfills are not lined, and the surrounding soil is often contaminated by leachates from them. Windborne debris also pollutes the surrounding areas. A proportion of waste from large enterprises together with that from smaller ones is often disposed of in municipal landfills, resulting in mixed disposal of hazardous and non-hazardous waste.

The estimated amount of municipal waste generated in Bulgaria in 1992 was 8.1 million tonnes. This waste has two notable characteristics: a high proportion of food and garden waste; and significant amounts of ash from coal used for domestic heating. Two thirds of the population is served by municipal waste collection and 95 per cent of municipal waste collected is landfilled. The precise number of landfills is not known, as there is no licensing system, but it is known that there are at least 300 urban landfills and 1300 small rural ones. Most of these are uncontrolled dumps which are a significant source of pollution, mainly of groundwater. In general, landfill capacity is insufficient and some of the larger municipalities, including Sofia, are facing a capacity crisis.

The hazardous waste generated in Bulgaria in 1992 amounted to 1.5 million tonnes, of which 46 per cent was of mineral origin and 43 per cent was sludge from waste water treatment plants, often contaminated with considerable amounts of heavy metals. Most hazardous waste, including that from hospitals, is landfilled.

The 1992 Environmental Strategy provided guidelines for waste management and identified improving management of hazardous waste as a top priority. The Ministry of Environment has prepared a draft law on waste management covering industrial and municipal waste, including hazardous. The law proposes a permit system and would bring Bulgaria's legislation into harmony with EU regulations. However, the draft law had still not been submitted to the new parliament by the spring of 1995. The Environmental Strategy also called for a study to identify hazardous waste sites to determine the nature and extent of land contamination from past disposal practices. This was to be followed by risk-based prioritization and evaluation of the need for remedial action.

Future challenges

Overall, Bulgaria made progress in dealing with pollution problems in the years following the adoption of the 1991 Environmental Protection Law and the 1992 and 1994 Environmental Strategies, which strengthened the capacity of the Ministry of Environment. However, the country still lacks an adequate framework to control pollution. Pollution laws have been drafted but are not yet enacted, and there is a need to reform the system of very strict but unenforceable standards dating from previous decades. Air quality remains low in many cities and hot spots. Problems of water quantity and quality persist, as do problems of waste management and soil contamination, in spite of work done to improve the legislative framework. At present, the challenge for Bulgaria is to push ahead with the enactment of draft legislation and to concentrate its efforts on cost-effective and urgent actions.

This profile is based on information about Bulgaria in the OECD's Environmental Performance Reviews series. Some of the information may have changed since the OECD carried out its investigations. This series is available from OECD Publications, 2 rue André Pascal, 75775 Paris Cedex 16, France. +33 (1) 45.24.82.00, Fax: +33 (1) 49 10 42 76. Internet: Compte.pubsinq@oecd.org ◆

The Centre for Environment Education – raising environmental awareness in India

India's Centre for Environment Education (CEE) has been in existence since 1984, when it was established with the primary objective of improving public awareness and understanding of environmental issues. CEE pursues its objectives through educational programmes in a wide variety of areas. It is based in Ahmedabad and has three regional cells in Bangalore, Lucknow and Guwahati which support its core activities and generate their own projects and initiatives.

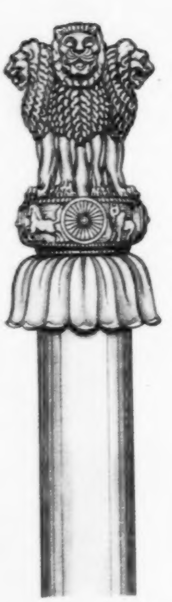
The CEE considers that environmental education is most effective if started early and has therefore developed a number of programmes for school children. Teaching methods and aids are regarded as every bit as important as course content in this area, and the CEE also provides extensive support and training for teachers.

In India, as elsewhere in the world, the media

Conservation: a tradition in India

Indian tradition has upheld the need for sustainable lifestyles. 2800 years ago, the Upanishads spoke of the need for restraint in resource use in order to protect the interests of future generations.

These fine traditions will continue to sustain us.

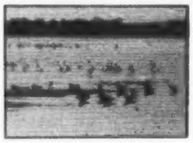


Asoka's pillar edicts (272-232 B.C.) proclaimed protection for plants and animals.

Religious tenets support the preservation of biodiversity through institutions like sacred groves.

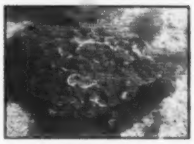
The Bishnois laid down their lives to save the destruction of their forest wealth in 1730 A.D.

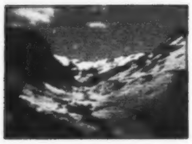
Ecological Profile

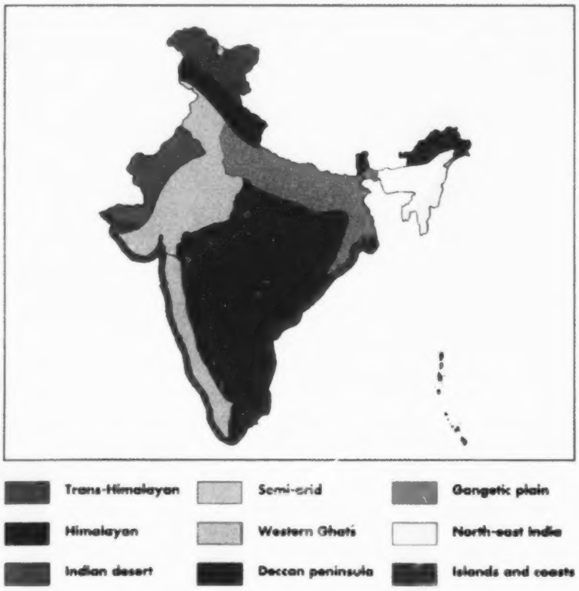


The country has the seventh largest land mass in the world, conditioned by land use, geographic and climatic factors into ten recognizably different bio-geographic zones.

These zones shelter a variety of ecosystems: mountains, plateaus, rivers, wetlands, lakes, mangroves, coral reefs, coasts and beaches, and forests.







can be a powerful tool for the dissemination of information on the environment. However, environmental concerns are often not reflected in the 20,000 newspapers and periodicals read by a significant section of the urban and rural populations. Many of these publications are in local languages and do not have access to readily usable environment-related items. To help to provide such material, the CEE's News and Features Service (CEE-NFS) supplies articles in both English and Hindi for non-exclusive use by several newspapers and magazines. The CEE also produces and distributes its own newsletters, including "Sampark", which is the Hindi version of the UNESCO-UNEP quarterly newsletter "Connect".

In India national commitment to *in situ* conservation has often created conflict situations locally, for example when communities living around areas declared national parks or sanctuaries suddenly lose access to their traditional resource base. Yet conservation efforts cannot hope to be successful if they come into conflict with local cultures and needs. The CEE addresses such problems by working out appropriate means of communications to foster a general understanding of the need to integrate environmental considerations into development strategy. Practical demonstrations are provided to show the superiority of ecologically sound projects and technologies and how these can generate income, to convince local people of the possibility of integrating environmental considerations into development strategy.

The rapidly increasing size of the urban population is placing acute stress on India's environment. The CEE organizes programmes to raise everyone's awareness of this problem, from slum dwellers to planners, as well as providing information on what they can do about it. Exchanges of ideas on environmental and urban development issues are encouraged through events such as seminars, symposia, meetings and exhibitions, and through urban programmes on community hygiene, solid waste management, and the protection of greenery and vegetation in the city.

In addition to its programmes, CEE also runs a nature discovery centre with activities aiming to foster concern for the natural environment by raising awareness of the beauty and harmony of nature.

For more information, contact: Centre for Environment Education, Nehru Foundation for Development, Thaltej Tekra, Ahmedabad, India.

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The EIA Centre, University of Manchester – research, training and advice on Environmental Impact Assessment

The Environmental Impact Assessment Centre (EIA Centre) at the University of Manchester, UK, has recently published a series of 17 leaflets covering, among other topics, EIA centres in Europe, sources and types of published information on EIA, EIA in developing countries, and EIA in transition economies.

The University of Manchester has been involved in EIA-related research, training and advisory activities since 1975. In 1988, the EIA Centre was established within the university's Department of Planning and Landscape to organize and develop EIA activities. Initially much of the Centre's work was concerned with EIA applications within the European Union and was partially funded by the European Commission. Current work is concentrating equally on countries outside of Europe, both developed and developing.

The Centre is engaged in a collaborative programme with the Development and Project Planning Centre (DPPC) at Bradford University, UK, to encourage the integration of EIA and project appraisal procedures into policy making in developing countries. The project programme includes: short courses in EIA/project appraisal for practitioners in both the UK and abroad; postgraduate training in EIA/project appraisal; research into the EIA/project appraisal interface; development of training material for EIA/project appraisal training and for training for trainers; studies of international and national authorities relating to EIA/project appraisal practice and policy; and an information network and database on EIA/project appraisal in developing countries. Other activities at the Centre include open conferences, seminars and courses on EIA-related themes, and the publication of a regular Newsletter.

For more information, contact: EIA Centre, Department of Planning and Landscape, University of Manchester, Manchester M13 9PL, UK. Tel: +44 (0161) 275 6873, Fax: +44 (0161) 275 6893.

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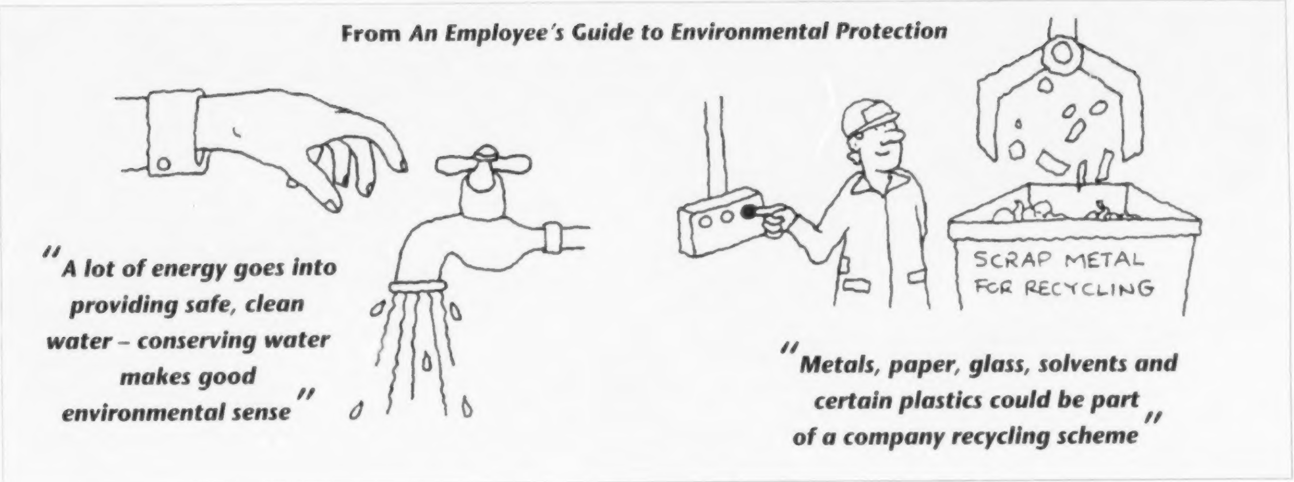
An Employee's Guide to Environmental Protection – bringing environmental awareness to the workplace

The Safety and Environment Department of the Engineering Employers' Federation has pro-



From *An Employee's Guide to Environmental Protection*

"A lot of energy goes into providing safe, clean water – conserving water makes good environmental sense"

"Metals, paper, glass, solvents and certain plastics could be part of a company recycling scheme"

duced a thirty-page leaflet entitled *Think About the Environment – An Employees Guide to Environmental Protection*, intended to help employees in all sectors understand how environmental issues relate to their daily work.

The leaflet begins with concise, illustrated explanations of global problems such as global warming, the ozone layer, and land contamination. Having thus explained the need for change, it goes on to suggest everyday actions which can be beneficial to both the environment and the company. These range from the very simple, such as switching off or turning down lights and equipment, or being careful not to use more cleaning materials than necessary, to more sophisticated schemes such as recycling, waste handling and disposal. Based on these practical suggestions, employees are then encouraged to incorporate environmental thinking into their working practice and to extend such thinking beyond the place of work.

For more information, contact: The Customer Services Department, EEF, Broadway House, Tothill Street, London SW1H 9NQ, UK.

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Industry Updates

European Auto/Oil Programme leads to new measures on vehicle emissions

As a follow-up to its Auto/Oil Programme, the European Commission is proposing a new round of standards for car exhaust emissions which could reduce road transport emissions by as much as 70 per cent in relation to present levels by 2010. The Auto/Oil Programme was set up by the Commission in 1992, in order to provide a firm technical basis to build on the progress made in reducing vehicle emissions since the first emissions Directive came into force in 1970. The Commission recognized that additional emission reductions up to and beyond the year 2000 would be increasingly difficult to achieve technologically and could be costly. Taking a comprehensive and "shared responsibility" approach, the Commissioners for Environment, Industry and Energy invited the European industrial associations for cars (ACEA) and for oil (Europa) to contribute their expertise and experience to this technical programme. Both industries agreed to participate and, together with the Commission, began work on what subsequently became known as the Auto/Oil Programme.

The programme's declared objective was "to provide policy makers with an objective assessment of the most cost-effective measures to reduce emissions from the road transport sector to a level consistent with the attainment of the new air quality standards being developed for adoption across the European Union." The programme examined combinations of cost-effective measures which would ensure that stringent air quality standards could be met by 2010 for nitrogen oxides, benzene in cities, carbon monoxide in cities, particulate matter in cities, and emissions of the precursors of tropospheric ozone.

The proposed new standards comprise two stages of implementation. The first includes measures to be applied to all new vehicle types by 2000 in order to give 20 to 40 per cent pollutant reductions in relation to 1996 levels. Reductions would be achieved by increasing the stringency of certain existing tests – such as tailpipe emissions after cold start and loss of hydrocarbons from fuel systems – and by the use of new technologies. Two technological measures are proposed for application to petrol-fuelled cars in the first phase:

◆ a requirement for the use of on-board diagnostics (OBD), which means the installation of sensors in a vehicle's exhaust system to allow monitoring of its emissions throughout its working life;

◆ in-use compliance testing, whereby durability of compliance of a given manufacturer's vehicles will be checked by surveys carried out on vehicles from that manufacturer having driven more than 80,000 km or over five years old. Systems of this type are already in operation in the US, Sweden and in the Netherlands.

The second stage proposed by the Commission gives indication of further measures which could be introduced in 2005 and which would result in emission reductions of between 50 and 70 per cent in relation to 1996 levels. These measures are based on the environmental technologies currently under development which show the most promise. They include catalytic convertors to remove nitrogen oxides from diesel exhausts ("de-NO$_x$") and pre-heated catalytic converters for cars. De-NO$_x$ converters would also require the availability of improved low-sulphur diesel.

The second stage has two aims. Firstly, by having indicative but realistic aims it gives prior warning to the automobile industry of measures likely to have to be applied after 2005. Secondly, it provides potential uniform targets for Member States to allow them to take initiatives to stimulate the relevant areas of technology.

The Commission will be putting its proposals to the Council of Europe and the European Parliament by 31 December 1999 at the latest.

For more information, contact: European Commission DG XI, Rue de la Loi 200, B-1049 Brussels, Belgium. Tel: +32 (2) 2999 1111.

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The Natural Step – combining basic science and economic sense

A number of interesting intiatives have been taken to help understand environmental problems and find solutions to them. One of these is The Natural Step, founded by Swedish oncologist Dr Karl-Henrik Robèrt in 1989, is to provide a common framework to For Dr Robèrt, much of the debate about environmental issues seemed self-defeating, with internecine arguments and theories holding back progress towards sustainable development. TNS aims to cut through these disagreements over details, and to recentre the debate, by demonstrating that environmental problems can be viewed in terms of basic hard science. Well established and now incontrovertible principles, such as the laws of thermodynamics and conservation of matter, were used as a basis to define four fundamental "system conditions" necessary for a sustainable society. These four conditions, shown below, form the basis of a framework which, although universally applicable, is nevertheless simple and flexible enough to allow people to develop actions which do not conflict with political, religious or personal beliefs.

The core principles of TNS remain unchanged regardless of context; it is the way they are communicated that is adapted, by those presenting the TNS concept, to suit the culture of a particular country or enterprise. The four conditions are:

1 – **Substances from the earth's crust cannot systematically increase in the biosphere**: for example, fossil fuels, metals and other resources must not be extracted at a faster rate than they are redeposited in the earth's crust.

2 – **Substances produced by society cannot systematically increase in the biosphere**: for example, substances must not be produced at a faster rate than they can be broken down and reintegrated into natural cycles.

3 – **The physical basis for the productivity and diversity of nature must not be systematically deteriorated**: for example, we must not harvest or manipulate ecosystems in such a way as to diminish their productive capacity or threaten biodiversity.

4 – **In order to meet the previous three system conditions, there must be a fair and efficient use of resources to meet human needs**, which means that basic human needs must be met in the most resource-efficient manner.

The basic method of dissemination is the one-day introductory workshop.

TNS is spreading. Around 50 companies and municipalities in Sweden are applying the principles to their operations, and they are being adopted by companies in the UK, New Zealand, Australia, the Netherlands, Norway, Denmark, Canada and the US.

An important multinational corporation taking an interest in TNS is Monsanto. Monsanto has been developing its own Sustainability Program, and environmental managers at the company recognize that the four system conditions – because they are basic, difficult to argue with, and easy to understand – can be very useful in environmental training. A delegation of Monsanto employees visited Sweden in January 1996 to meet with people in companies applying TNS principles. Dr Robèrt then gave a presentation to employees and senior management at the company's headquarters in June, and two TNS workshops were then planned.

In recent years environmental problems have multiplied and changed character, from local to global, and from distinct to diffuse. In this increasingly complex situation, simple and clear precepts like those of TNS, based on universally accepted scientific concepts, may provide a compass indicating the path to sustainable development.

For more infomration, contact: The Natural Step, 4000 Bridgeway, Suite 102, Sausolito, CA 94965, US. Tel: +1 (415) 332 9394, Fax: +1 (415) 332 9395.

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UNEP Focus

UNEP publishes the first in a series of Global Environment Outlook reports

In May 1995, UNEP's Governing Council requested a new, comprehensive report on the state of the global environment at present and in the year 2015. UNEP's response to this request was to set up the Global Environment Outlook Project (GEO Project), of which the primary product will be a series of biennial Global Environment Outlook reports. The first of these, known as GEO-1, was published in January 1997. The report provides a snapshot of the environment and the attempts being made to improve it. The principal focus of GEO-1 is a review of major environmental issues from regional perspectives, and an initial evaluation of existing and promising policy responses that address regional priority concerns.

In addition to describing the background to the GEO Project, the GEO-1 report analyzes seven major environmental issues for seven different regions. The issues covered are: land, forests, biodiversity, water, marine and coastal environments, atmosphere, and urban and industrial environments. The regions are Africa, Asia and the Pacific, Europe, Latin America and the Caribbean, North America, West Asia, and the Polar Regions.

The report also summarizes policy responses to environmental issues in different regions and concludes with a series of quantative analyses of major environmental issues based on model analyses.

In preparation for future reports, the GEO Project will continue to address crucial environmental questions such as:

◆ What are the major regional and global environmental problems, both current and emerging?

◆ What are the major demographic, social and economic driving forces behind the observed problems and trends?

◆ Where are we heading if we continue doing "business as usual"?

◆ Where do we want to be heading?

◆ What is being done to address environmental concerns and what can be done in the future to move forward on the path of sustainable development?

To achieve its goals the GEO Project has engaged in a regional and participatory process relying on a global network of Collaborating Centres, Working Groups and United Nations agency participation. The long-term aim of the process is to provide an effective mechanism for international environment policy setting, involving experts and decision makers from industrial and developing countries and from international agencies as equal partners.

Although it concludes that, during the past decade, the environment has continued to degrade and that significant problems persist, GEO-1 also identifies areas of progress. One of these, illustrated throughout the report's regional policy sections, is the move by countries towards cleaner production. Government environmental policies to stimulate market partners to move from end-of-pipe solutions to more integral approaches are being tested in a number of countries. There is an obvious and urgent need, the report concludes, to distribute such knowledge and expertise world-wide.

As a logical follow-up to the GEO-1 report, GEO-2 will provide further analysis of the priority issues identified in GEO-1, on the basis of work to be done in 1997 and 1998.

Message from UNEP's Executive Director on the occasion of World Environment Day, 5 June 1997

Today we celebrate World Environment Day – a day to bring our focus towards something that cries for our attention 365 days a year – that fragile speck of dust in the vast cosmos that we call our home – the earth.

World Environment Day 1997 is special. This year the United Nations Environment Programme celebrates a number of significant milestones since its creation 25 years ago at the Stockholm Conference. This year, the world also marks the 10th anniversary of the historic negotiation of the Montreal Protocol to preserve the ozone layer; 10 years since the groundbreaking Brundtland report; and five years since world leaders gathered in Rio for the Earth Summit.

This happy coincidence of celebrations is symbolic of one common purpose: the preservation of life on earth.

Just as no two fingers are identical, so no two beings are alike. Every country has its own unique culture and traditions.

But there is one universal message which can embrace the entire world. A message which is common to different national governments, to people who bear no resemblance to each other, to cultures alien to one another.

It is the message of the sanctity of life on earth. And this is the theme for this year's World Environment Day: "For Life on Earth".

To a visitor from another planet the world would present a spectacle as melancholy as it is bewildering. It would see civilization in danger of perishing under the oppression of a gigantic paradox. It would see multitudes of people starving in the midst of plenty. It would observe that even with a steady growth in our technical ability there is a seemingly inexorable deterioration of our environment.

According to UNEP's recently released Global Environmental Outlook report, the quickening pace of our assault on the environment continues to be dramatic in its impact.

Global warming, the depletion of the ozone layer, the decline of biological diversity, the loss of soil and forests, the contamination of our fresh water supplies and even the great oceans, vanishing fisheries, the flood of toxic substances entering our environment and our bodies and threatening our health – all signal that we continue to make excessive demands on the global environment that sustains us.

But we are not visitors from another planet. We are the inhabitants of the earth.

This is our world, and we must make the best of it. Whatever we do, or fail to do, will influence the future of life on earth.

By throwing our joint weight into the scales of history on the right side, we can tip the balance decisively in favour of a healthy environment which can sustain life on earth.

The sanctity of life on earth should find expression in all our actions. In understanding that human wealth and economic development ultimately derive from and depend upon the resources of the earth; in seeing economic development and care for the environment as compatible, interdependent and necessary; in knowing that economic development can help solve environmental problems only if it is accompanied by an attitude of responsibility and stewardship for the earth; and in knowing that the key to socially sustainable development is the participation, organization, education and empowerment of people.

On this World Environment Day, let us not despair, but instead examine the state of our environment. Let us consider carefully the action which each of us must take and then address ourselves to our common task of preserving life on earth in a mood of sober resolution and quiet confidence.

Let this World Environment Day become a celebration of our past achievements, but most importantly a vehicle for establishing a universal concord for all living beings, for establishing peace and for nurturing our ecological heritage.

For more information, contact: United Nations Environment Programme, P.O. Box 30552, Nairobi, Kenya.

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UNEP/Chemicals Newsletter

UNEP/Chemicals (IRPTC) is pleased to introduce a new newsletter, replacing the *IRPTC Bulletin*. Regular readers of the bulletin should continue to find this short but timely twice-a-year newsletter useful in keeping them informed of UNEP's chemicals-related activities. Volume 1, No. 1 (January 1997) contains status reports on the negotiations for legally binding instruments on Prior Informed Consent (PIC), as well as activities underway to address global issues concerning Persistent Organic Pollutants (POPs). Other initiatives, such as international activities to advance Pollutant Release and Transfer Registers (PRTRs) and efforts to promote the exchange of information on toxic chemicals and to assist countries in building their national capacities for sound management of chemicals, are also summarized. Regular international updates will be provided on chemicals-related meetings and reports, as well as on the establishment of information clearing-houses and Internet sites providing information on chemicals.

Many readers will note the change in the name of IRPTC (the International Register of Potentially Toxic Chemicals) to UNEP/Chemicals. UNEP/Chemicals will continue to maintain a register of toxic effects of chemicals, and IRPTC will remain a component of UNEP/Chemicals. This expansion was necessary, as our activities have changed from just maintaining a register to catalyzing global actions on chemicals through the PIC and POPs work. UNEP/Chemicals also has a broader role in helping countries obtain information on chemicals and assisting in capacity-building work. The new name therefore reflects a substantive change in the focus of UNEP work.

For information, please contact: The Director, UNEP/Chemicals, GEC, 15 chemin des Anémones, CH-1219, Châtelaine, Geneva, Switzerland. Tel: +(41.22) 979.91.10, Fax: +(41.22) 797.34.60. E-mail: IRPTC@unep.ch.

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UNEP IE activity summary

UNEP IE works on a wide range of issues through several distinct Programmes. A number of the Programmes produce their own quarterly or biannual newsletter, describing their work in more detail. For more information on all activities mentioned, contact UNEP IE.

Awareness and Preparedness for Emergencies at Local Level (APELL)

See the APELL Newsletter on page 83 for news of Programme activities.

Cleaner Production (CP)

See the Cleaner Production Newsletter on page 87 for news of Programme activities.

OzonAction

The OzonAction Programme hosted the 6th Meeting of the Informal Advisory Group, to review UNEP's activities as an implementing agency under the Multilateral Fund and to plan the direction of the 1997 Work Programme activities.

At its 21st meeting (Montreal, 18-20 February), the Executive Committee of the Multilateral Fund approved UNEP's 1997 Work Programme and noted UNEP's 1997 Business Plan. In addition to UNEP's core clearinghouse activities, the ExCom approved three Country Programmes (St Kitts & Nevis, DPR Korea, Paraguay), four Institutional Strengthening projects (St Lucia, St Kitts & Nevis, DPR Korea, Paraguay), projects for the development of Refrigeration Management Plans (Guinea, St Lucia, Bahamas, St Kitts & Nevis, Dominican Republic, Antigua & Barbuda, Guyana), national training projects in refrigeration (Argentina, Guatemala, Peru), and a policy workshop in China (to be jointly conducted with UNDP).

OzonAction Newsletter, No. 21 was published and disseminated, as were two documents developed jointly with the Stockholm Environment Institute: *Monitoring of Imports of ODS* and *Regulations to Control ODS*. Awareness stickers were produced for the 10th Anniversary of the Montreal Protocol with the text "1999 – Do Not Increase Production and Consumption of CFCs", and were distributed at the UNEP Governing Council. The OzonAction Programme, in cooperation with the Ozone Secretariat, also began planning other activities related to the 10th Anniversary celebrations.

Saving the Ozone Layer: Guidelines for United Nations Offices was also published as a response to a decision by the Governing Council (GC 18/10) on "greening of the United Nations system". This was disseminated at the CSD meeting in April, during a session on "Greening of the UN".

The National Training Course on Chillers and Refrigerant Management was organized in Jakarta on 26-27 Feb 1997, jointly by the Government of Indonesia and the OzonAction Programme.

The Follow-up Meeting for the Network of ODS Officers in the South East Asia and Pacific Region was organized jointly by the OzonAction Programme and the UNEP ROAP Office (Melbourne, 28 February-2 March).

A representative of the Programme also participated in the "Life After Halons Conference" (Melbourne, 26-27 February), including making presentations and facilitating a session on Development of a Regional Strategy on Halons. Additionally, OzonAction Programme staff visited GTZ (Eschborn, Germany) to discuss bilateral and multilateral projects on hydrocarbons from the point of view of ozone layer protection and climate change. Refrigerant management plans are being prepared, in cooperation with the French Caisse Française de Developpement, for low ODS-using countries.

Tourism Programme

See page 95 for news of activities of the Tourism Programme.

Global Industrial Management

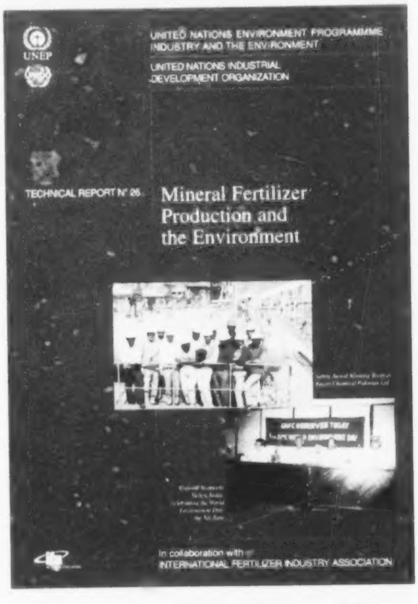
A new version of the EMS Kit was printed in January 1997.

At the invitation of the Thai Business Council for Sustainable Development (TBCSD), UNEP IE organized a corporate environmental reporting workshop in Bangkok for over 20 Thai industrialists on 6 February 1997. Many of the representatives expressed a strong interest in preparing an environmental report, and UNEP will continue to work with the TBCSD to support this. The aim is to have a minimum of five companies issuing CERs by the end of 1997.

An EMS train-the-trainers seminar was held in Shanghai on 7-11 April 1997. Over 25 representatives from local Environmental Protection Bureaus participated in the seminar, organized jointly by NEPA, UNEP and the China Center for Environmental Management.

Industrial Pollution Management

The *Mineral Fertilizer Production and the Environment* technical report, produced by UNEP and UNIDO in collaboration with the International Fertilizer Industry Association, was published in February 1997. The report is intended to raise awareness of the environmental issues inherent in the manufacture of fertilizers and to highlight the approaches that industry and government may adopt, preferably


UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND THE ENVIRONMENT

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

TECHNICAL REPORT N° 26

Mineral Fertilizer
Production and
the Environment

In collaboration with
INTERNATIONAL FERTILIZER INDUSTRY ASSOCIATION

in concert, to avoid or minimize the associated impacts.

Also in February a consultant, Mr Lesley Blinker, submitted the joint UNIDO/UNEP report on mercury pollution from small-scale gold mining in South America.

In March, Mr Blinker completed the joint UNDP/UNEP regional training workshop on Environmental Management of Mine Sites in Guyana.

Ongoing preparatory work continued throughout the months of March and April for the forthcoming conference on environmental education for engineering professions, in collaboration with WFEO, WBCSD and ENPC. The conference will be held in Paris in September 1997.

Work also continued throughout the first quarter of 1997 on preparation and editing of a technical guide on Environmental Management in the Pulp and Paper Industry.

Energy

Since January 1996, UNEP's Energy Programme has been part of the Sustainable Production and Consumption Programme and has been coordinated from UNEP IE in Paris.

Consistent with the other programmes at UNEP IE, the Energy Programme's proposed strategy is to:

- support implementation of the FCCC through catalyzing implementation of no- and low-cost technologies and policies and promoting a prevent rather than cure philosophy;
- promote information exchange and raising awareness by undertaking joint projects with strategic allies so as to leverage resources and increase catalytic impact;
- develop and disseminate practical policies, strategies, and tools :
- enhance capacity in developing and transitional countries;
- act as a broker between North and South, industry and government.

One of its main priorities is to create better leverage by working in close cooperation with strategic partners in industry, government, and NGOs. In addition, the Energy Programme is supported by UNEP's Collaborating Center on Energy and the Environment at Riso, Denmark.

At present, the Energy Programme is focusing on three thematic areas:

- promoting energy efficiency technologies and policies and low environmental impact energy resources;
- catalyzing use of tools, methods, and approaches that incorporate environmental principles into energy sector analysis;
- assessing the environmental impacts of power sector restructuring.

Various activities are now underway in each of these areas, including:

- preparation of a guidance document on setting up voluntary programmes for energy efficiency in developing countries. This is being undertaken in conjunction with the US EPA's Atmospheric Pollution Prevention Division and Environment Canada;
- preparation of a manual on energy auditing at industrial facilities in developing countries. This is being jointly prepared with UNIDO;
- preparation of a booklet of case studies highlighting successful applications of sustainable energy technologies and the lessons learned. This document will be prepared together with the Bonn-based European Business Council for a Sustainable Future and the Washington, D.C.-based Business Council for Sustainable Energy.

UNEP's Energy Programme also has some activities underway in the transportation sector. For example, in December 1996, UNEP IE working in collaboration with OECD held a consultative meeting on the reduction of lead in gasoline. This forum provided experts from key international organizations and industries with the opportunity to exchange information and explore ways of collaborating. Several activities to be carried forward were identified. Participants also made key proposals for cooperation and coordination which include, for example, the need to identify and assess policy options for addressing the problems caused by older gasoline-fuelled vehicles in developing countries. The results of the meeting will be forwarded to various forthcoming meetings organized by the International Petroleum Industry Environmental Association, the United Nations Commission for Europe, and the European Conference of Ministries of Transport.

The UNEP Collaborating Centre on Energy and the Environment (UCCEE) also has a number of activities underway in the three thematic areas outlined above.

Recently completed national studies on energy and the environment include:

- In India, UCCEE worked with the Indira Ghandi Institute of Development Research to prepare a report entitled "Environmentally sound Energy Efficient Strategies: A Case Study of the Power Sector in India".The report was published in February 1997.
- In China, UCCEE and China's National Environmental Protection Agency published a report on "Incorporation of Environmental Considerations in Energy Planning in the People's Republic of China".
- In Zimbabwe, UCCEE joined hands with the Southern Centre for Energy and the Environment and the National Environmental Engineering Research Institute in India to prepare the report, "Implementation Strategies to Reduce Environmental Impact of Energy Related Activities in Zimbabwe".

UCCEE is in the final phases of completing a training manual for Integrated Resources Planning and Demand Side Management. The document has been prepared with the University of Campinas, Brazil, and will be published in mid-1997 in English and Portuguese.

One of the most important activities at UCCEE is the support given to developing countries to help implement the UN Framework Convention on Climate Change. UCCEE is one of the main institutions developing guidelines for assessing options to mitigate emissions of greenhouse gases. In parallel with this activity, UCCEE is helping to enhance capacity to address climate change in developing countries and transitional economies through Enabling Activities and other technical support.

Finally, UCCEE has several training activities in the pipeline. In May 1997, UCCEE will convene a training workshop on mitigation methods in Mauritius for at least 14 countries and, in June 1997, it will be convening an IPCC-sponsored workshop on economic and social impact assessment in Copenhagen, Denmark.

Two workshops are forthcoming:

The UNEP Collaborating Centre on Energy and Environment is organising a workshop on "Mitigation and Adaptation Cost Assessment – Concepts, Methods and Appropriate Use". The workshop will take place at Riso National Laboratory, Denmark, from 16 to 18 June 1997 and is co-sponsored by the Intergovernmental Panel on Climate Change (IPCC), the Danish Government, Risø, UNEP, the Asian Development Bank (ADB) and the German Technical Cooperation (GTZ).

IPCC is in the period between the finalization of the Second Assessment and the commencement of the next full assessment process. It is undertaking a number of activities (special reports, papers, workshops, etc.) and the present workshop is a part of this process.

In addition, the IPCC requested the preparation of a discussion paper on "Mitigation and Adaptation Cost Assessment – Concepts, Methods and Appropriate Use".The responsibility for beginning the preparation of the paper has been given to the UNEP Collaborating Centre on Energy and Environment and the Lawrence Berkeley National Laboratory, USA.

The draft of this paper will be presented in detail at the workshop.

Based on the outcome of the workshop, the paper may subsequently be circulated for peer and government review prior to formal IPCC adoption and publication as an IPCC methodology paper.

Secondly, UNEP IE and the International Energy Agency (IEA) will jointly convene a workshop in Paris in July 1997 to consider approaches which would create incentives for private sector companies to compete for carbon reductions through AIJ. The workshop will bring together a select group of invited participants from industry (potential project developers), government (those in OECD countries able to provide industry with incentives to undertake AIJ plus non-Annex I countries with interest to develop AIJ), and NGOs.

At this stage, AIJ has entered into an important phase where its credibility, feasibility and desirability are being debated. This debate was clear at UNEP's Open Forum on AIJ held in Costa Rica in October 1996 and at the Conference on Developing Countries' Perspectives on AIJ held in New Delhi, India, in January 1997. What is needed is the realisation of more viable AIJ projects during the pilot phase. This would lead to the accumulation of experience which would be highly relevant in the post-pilot phase.

UNEP and IEA propose to convene this workshop to evaluate and further develop solutions to the apparent lack of incentives for AIJ project development during the pilot phase.

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UNEP Industry and Environment in the regions

The TierrAmérica newspaper supplement – promoting clean industry in the Latin America and Caribbean region

The first 1997 issue of TierrAmérica, the two-monthly newspaper supplement produced by the United Nations Environment Programme's Regional Office for Latin America and the Caribbean (ROLAC), was on the subject of clean industry. The issue gave examples of clean industries and helped to promote awareness of the concept through contributions from people in key sectors combined with features from, amongst others, the President of the Business Council for Sustainable Development in Latin America and the Director General of the United Nations Industrial Development Organization.

TierrAmérica, which means land of America, is published regularly in 12 major newspapers in 11 countries in Latin America. It provides an open forum for discussion of the challenges facing the planet and helps to promote awareness of environmental issues of particular relevance to the region. Each issue addresses a specific topic and covers various aspects of it, such as political implications or economic, cultural and social impacts.

TierrAmérica aims to be a vector for increased environmental responsibility amongst the citizens of the region by giving them a better understanding of issues and encouraging public participation in the search for solutions to environmental problems.

With distribution in so many countries, a circulation of over a million copies and a readership of more than 3 million, TierrAmérica is also an effective instrument for promotion of the regional integration required to achieve a joint response to common environmental problems.

For more information, contact: United Nations Environment Programme, Regional Office for Latin America and the Caribbean, Boulevard de los Virreyes No. 155, Col. Lomas de Virreyes, Apdo. Postal 10-793, CP 11000, Mexico. Tel: +52 (5) 202 69 13 and +52 (5) 202 74 93, Fax: +52 (5) 202 09 50 and +52 (5) 202 77 68.

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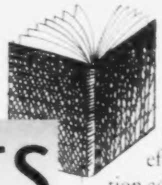

Books & Reports

GENERAL

Driving Eco-Innovation – A Breakthrough Discipline for Innovation and Sustainability

Driving Eco-Innovation, by Claude Fussler and Peter James, provides an insight into why business is losing its innovation stamina and shows how this situation can provide opportunities to create competitive advantage for those who have a long-term vision.

The book presents the nuts and bolts of the eco-innovation approach in detail, enabling readers to carry out their own hands-on experiments and ultimately provide products and services that are environmentally efficient and economically profitable, in other words eco-efficient.

Driving Eco-Innovation takes a broad look at the issues and trends that are shaping the markets for eco-efficient products and processes, including: an understanding of external stakeholders and the value of partnerships with them; a model of long-term technology development and adoption; the eco-efficiency compass – a detailed explanation of the six dimensions of eco-efficiency and how to assess the score for each; essential information on the three key drivers which will determine the future – demographics, environmental stress and value creation; how to carry out environmental accounting and how to apply it to business; briefings on the UNEP Cleaner Production Programme and the World Business Council for Sustainable Development's concept of eco-efficiency; and case histories of companies which have achieved eco-efficiency and made significant innovation advancement.

By spelling out the meaning of fundamental trends which managers may be too busy to see or to stop and reflect on, *Driving Eco-Innovation* highlights opportunities to save time, resources and money and to improve performance for new business development.

Claude Fussler and Peter James (1997). Pitman Publishing, 128 Long Acre, London WC2E 9AN, UK. Tel: +44 (0171) 447 2000, Fax: +44 (0171) 240 5771. Hbk, 364p. ISBN 0-273-62207-2.

Policies for a Small Planet

Policies for a Small Planet, from the International Institute for Environment and Development, is an integrated series of essays on the policies required for sustainable development. The essays focus on developing countries, addressing the specific sectors to which such policies must be applied. They begin with a discussion of what constitutes sustainable development and then look at the institutional arrangements needed to mobilize human resources for change and economic policies for sustainable natural resource management. Policies for agriculture, urban development, industry, forests, drylands, energy use, finance, population and consumption are discussed.

Johan Holmberg, ed. (1994). Earthscan Publications Ltd., 120 Pentonville Road, London N1 9JN, UK. Pbk, 362p. ISBN 1-85383-132-8.

The Global Environmental Goods and Services Industry

According to this study from the OECD, the environment industry market is currently estimated at US$ 25 billion. The industry supplies pollution control and reduction, clean-up and waste handling equipment, and a growing range of other services. Demand is driven by the introduction of environmental standards and regulations and by increased public awareness.

The Global Environmental Goods and Services Industry looks at the present state of the industry and examines the potential for its development, as well as the impact that current policies are having on it.

(1996). *OECD Publications, 2 rue André Pascal, 75775 Paris Cedex 16, France. +33 (1) 45 24 82 00, Fax: +33 (1) 49 10 42 76. Pbk, 42p. ISBN 92-64-14693-8.*

Factor Four – Doubling Wealth, Halving Resource Use

Factor Four – Doubling Wealth, Halving Resource Use is the published version of a new report to the Club of Rome, one of the first organizations to create awareness of the unsustainable nature of our use of resources. It is written in the context of the "Factor 10 Club Declaration", already presented in Industry and Environment (1995, Vol. 18, N° 4). The new report proposes solutions to this dilemma by indicating ways in which greater efficiency can be achieved, often at no cost and even at a profit. The essence of the Factor Four concept is that resource productivity can, and should, grow fourfold. This, the authors claim, would allow us to "live twice as well – yet use half as much".

In support of their case, they present twenty examples of products which quadruple resource productivity. These range from high-efficiency light bulbs to radical new designs for transport systems.

Subsequent chapters discuss the shortcomings of many of the indicators currently used to measure the well-being of nations, pointing out how even negative events such as car accidents – which certainly do not increase the well-being of those involved – will be shown in GDP as adding to national wealth. Alternative indicators and methods of measurement are proposed, and cultural aspects discussed. The authors point out that the concepts they are proposing are not inherently complex and that the technological solutions to implement the changes they argue for already exist. The barriers, they claim, are more in the minds of mainstream engineers, architects, economists and politicians. The key to change lies in changing attitudes.

Ernst Von Weizsäcker, Amory B. Lovins, L. Hunter Lovins (1997). Earthscan Publications, Ltd. 120 Pentonville Road, London N1 9JN, UK. Tel: +44 (0171) 278 0433, Fax: +44 (0171) 278 1142. Hbk, 322p. ISBN 1-85383-407-6.

Resource Flows: The Material Basis of Industrial Economies

Conventional national economic accounts do not make explicit many activities that entail environmental modifications or uses of natural resources which have potential environmental impact. Measures such as Gross Domestic Product (GDP), for example, do not include the movement or processing of large quantities of materials that have no (or even negative) economic value. *Resource Flows: The Material Basis of Industrial Economies* presents a study of four high-income industrial economies – Germany, Japan, the Netherlands and the US – and demonstrates an alternative national accounting approach. The study proposes a new summary measure: the Total Material Requirement (TMR). The TMR is a measure of the physical flows, or the magnitude of economic activity measured in physical terms, that underpin an industrial economy. The TMR complements monetary measures of a nation's economic activity such as the GDP. Taken together, physical and monetary measures provide a more complete view of the size and scope of an industrial economy.

(1997). WRI Publications, P.O. Box 4852, Hampden Station, Baltimore, MD 21211, USA. Tel: +1 (800) 822 0504. Pbk, 66p. ISBN 1-56973-209-4.

European Conference on Urban Innovations – Seville, 6-8 October 1993

As part of a four-year programme (1993-96), The European Foundation for the Improvement of Living and Working Conditions undertook a research project called "Innovations for the Improvement of the Urban Environment". The European Conference on Urban Innovations completed the first phase of the research. Its published proceedings are now available.

(1994). European Foundation for the Improvement of Living and Working Conditions, Wyattville Road, Loughlinstown, Co. Dublin, Ireland. Tel: +353 (1) 204 3100, Fax: +353 (1) 282 6456. Pbk, 181p. ISBN 92-826-7958-6.

Utopias and Realities of Urban Sustainable Development – New Alliances between Economy, Environment and Democracy for Small and Medium-Sized Cities

In 1993 the European Foundation for the Improvement of Living and Working Conditions initiated a project on medium-sized cities and socio-economic and environmental development in the European Union. The objective was to explore the potential of medium-sized cities and the opportunities they provide for urban and regional development in the new European context. A conference, known as the Piedmont Conference, was organized in September 1996. Many of the papers presented on that occasion have been published and are now available.

(1997). *European Foundation for the Improvement of Living and Working Conditions, Wyattville Road, Loughlinstown, Co. Dublin, Ireland. Tel: +353 (1) 204 3100, Fax: +353 (1) 282 6456. Pbk, 365p. ISBN 92-827-9800-3.*

Perceiving, Conceiving, Achieving the Sustainable City – A Synthesis Report

This publication provides a synthesis of work arising from the European Conference on Urban Innovations (1993), which identified four areas for subsequent analysis: eco-auditing and local authorities in Europe; SMEs and the revitalization of European cities; transport and public spaces, the connective tissue of the sustainable city; and functionality, desirability and aesthetics of the sustainable city. This synthesis report examines some of the messages emerging from these analyses.

(1997). *European Foundation for the Improvement of Living and Working Conditions, Wyattville Road, Loughlinstown, Co. Dublin, Ireland. Tel: +353 (1) 204 3100, Fax: +353 (1) 282 6456. Pbk, 64p. ISBN 92-827-9704-X.*

International Examples of Sustainable Product Development – Directory of 35 Examples

As part of its International Examples of Sustainable Products project, the UNEP Working Group on Sustainable Product Development has compiled a directory of examples of sustainable product development. The aim is to establish a data base for study of examples and for the promotion and dissemination of sustainable products. At present the data base contains 35 examples, presented in the directory, with a description, contact details and illustrations. The examples in the data base can be printed in a variety of formats for publication, workshops or other uses. They are also available on a Web site.

(1997). The General Administrator, UNEP-WG-SPD International Centre, 3rd Floor, J.H. van 'tHoff Institute, Building 'B', Nieuwe Achtergracht 166, 1018 WV Amsterdam, the Netherlands. Tel: +31 (20) 525 6268, Fax: +31 (20) 625 8843. Pbk, 140. Web site: http://unep.frw.uva.nl.

What Future for Urban Environments in Europe: Contribution to Habitat II

What Future for Urban Environments in Europe: Contribution to Habitat II represents the contribution of the European Foundation for the

Improvement of Living and Working Conditions to the Habitat II Conference (Istanbul, June 1996). The Foundation's work in the years 1993-1996 focused mainly on urban innovations and medium-sized cities in the European Union and included the identification of best practices and the development of urban sustainability indicators, two themes of concern to the conference.

The first part of the publication presents interviews with the ministers responsible for urban affairs from all Member States of the European Union, providing an insight into how visions for the future are formed and actions decided on at national level. The second part presents examples of the Foundation's work on best practices and urban indicators.

(1997). *European Foundation for the Improvement of Living and Working Conditions, Wyattville Road, Loughlinstown, Co. Dublin, Ireland. Tel: +353 (1) 204 3100, Fax: +353 (1) 282 6456. Pbk, 157p. ISBN 92-827-7022-2.*

Environment and Health 1: Overview and Main European Issues

This joint publication by the European Environment Agency (EEA) and the WHO European Centre for Environment and Health (ECEH) draws attention to some of the environmental issues that are having significant impacts on the health of the European population.

The book draws on the large amounts of data gathered by the EEA and the ECEH for a brief discussion of the contribution of environmental factors to the main causes of death in Europe. It then presents an examination of three especially significant issues: air pollution by suspended particles, the microbiological contamination of drinking water, and road traffic accidents. These problems are widespread throughout Europe but could be at least partially alleviated within a short time by coordinated action. *Environment and Health 1: Overview and Main European Issues* not only identifies the issues but also describes goals and strategies for immediate action.

(1996). Office of Publications, WHO Regional Office for Europe, Scherfigsvej 8, DK-2100 Copenhagen, Denmark. Pbk, 56p. ISBN 92-890-1332-X.

Environmental Impact Assessment Training Resource Manual

This manual presents training resource material for environmental impact assessment (EIA), one of the core elements of integrated decision making in the areas of environment and development.

EIA is now a well established and proven process for project planning and management. The manual is designed to support the building of capacity for the process through training and to encourage networking among environmental professionals, especially in developing countries. It is intended to provide an understanding of, and basic capability in, the application of EIA. It can be used by trainers who have some background experience and understanding of EIA to identify training needs, and to facilitate the design and delivery of training courses.

The manual can be used to design and prepare different types of courses, from short introductory presentations for government officials, demonstrating the benefits of EIA and its role in sustainable development, to month-long courses providing detailed information to EIA practitioners.

In addition to its use as supporting material for course design, the manual can also help trainers identify local sources of information and contacts to make training more relevant, useful and interesting to participants.

The manual has four main sections: an introduction outlining the role of EIA in capacity building; a description of training needs analysis which can be used to identify or confirm specific training needs; advice on how to design, present and evaluate training courses; and a series of training topics covering the key steps in the EIA process.

The *Environmental Impact Assessment Training Resource Manual* represents a departure from earlier approaches in that it does not provide an already designed training course or programme for a specific target group in a particular country. The aim of the manual is rather to provide a tool to assist trainers in preparing courses which are relevant to existing local political, social and economic conditions and to local development priorities. It also represents the starting point for a comprehensive programme of training to support capacity building and to translate the principles of sustainability into operational terms.

(1996). Environment and Economics Unit, United Nations Environment Programme, Box 30552, Nairobi, Kenya. Tel: +254 (2) 62 3372/1, Fax: +254 (2) 64 4268. Ring binder, 699p.

Challenges and Approaches to Incorporating the Environment into Business Decisions – Invitational Expert Seminar, Opio, Provence, France, June 3-5, 1996

This publication contains papers from the seminar of the same name, arranged within the framework of the UNEP Cleaner Production Programme's Working Group on Policies, Strategies and Instruments to Promote Cleaner Production. The focus of the seminar was the challenges and approaches to incorporating environmental costs into business decisions. Decision-supporting tools developed in recent years were presented and their practical applications examined. A key issue was whether these tools are effective in delivering a road map towards sustainable development, including cleaner processes, products and services.

Papers from the seminar covering a broad range of aspects of the incorporation of the environment into business decisions are presented in this publication, ranging from in-depth analysis of application of tools and methods in the energy sector to performance indicators and public accountability and reporting.

(1996). IIIEE, Lundt University, P.O. Box 196, S-221 00 Lundt, Sweden. Tel: +46 (46) 222 0200, Fax: +46 (46) 222 0210. Pbk, 235p. ISSN 1407-0798.

Managing for Local Sustainability

Managing for Local Sustainability is about the sustainable management of social, economic and environmental resources at local level. The contents are based on the authors' five years of experience working closely with local governments throughout Australia.

The book is divided into five sections, entitled: Working towards local sustainability; Policy-making for local sustainability; Problem-solving for local sustainability; Practicing local sustainability; and Place, the basis of local sustainability. Each of these can be read as a self-contained whole by readers interested in a particular theme. Key concepts such as integrated environmental, social and economic management, and monitoring of the whole decision-making cycle, are present in every section, illustrated by informative case studies.

Valerie A. Brown, ed. (1997). Local Sustainability Project, School of Applied and Environmental Sciences, University of Western Sydney, Hawkesbury, Richmond NSW 2753, Australia. Tel: + 61 (045) 701518, Fax: +61 (045) 701518. Pbk, 314p. ISBN 0-642-264646-3.

Environmental Awareness and Obligations – An Australian Management Perspective

Where the environment is concerned, managers today often face a bewildering array of sometimes conflicting scientific theories as well as greater public awareness and increasing political will. These pressures combine to impose a high level of environmental responsibility on those in authority. This is demonstrated by a growing amount of environmental legislation increasingly imposing severe penalties on corporations and individuals alike for both willful and accidental acts causing environmental damage. Knowledge of environmental issues is therefore now a vital part of any manager's repertoire, yet many of them have difficulty in keeping up with the rapidly changing demands. *Environmental Awareness and Obligations – An Australian Management Perspective* is a manual designed to provide managers and others in charge of both private and government organizations in Australia and New Zealand with the necessary background to understand the environmental issues facing their organizations both at present and in the future.

The first section of the manual puts environmental issues into their historical and global contexts, describing major accidents which have occurred and giving some leading statistics such as the number of hectares of tropical rainforest destroyed and the amount of oil spilling into the sea throughout the world in a single day. Global problems such as climate change and ozone depletion, and their relevance to industry, are then explained. Once these foundations of awareness have been laid, the manual goes on to look at concepts such as sustainable development, government reactions to environmental problems, and environmental management systems.

The manual is regularly updated to keep managers abreast of current and emerging issues and of their changing responsibilities.

Graham Brown (1996). Centre for Professional Development (Aust.) Pty Ltd., ACN 006 964 076, 1st Floor, 35 Cotham Road, Kew, Victoria 3101, Australia. Tel: +61 1800 036 186, Fax: +61 (03) 9853 0342. Ring binder, 1211p. ISBN 1-86339-120-7.

Environmental Management Systems Guidebook

This guidebook is designed to provide environmental practitioners with a practical step by step guide to developing an effective environmental management system (EMS). It makes constant reference to the ISO 14000 series of standards as well as providing comparison with British Standard BS 7750 and the European Economic Community Regulation N° 1836/93.

In writing the guidebook it has been assumed that readers are familiar with environmental issues and are looking for specific guidance in creating an EMS. Readers for whom this is not the case are referred to the companion text by the same author.

Graham Brown (1996). Centre for Professional Development (Aust.) Pty Ltd., ACN 006 964 076, 1st Floor, 35 Cotham Road, Kew, Victoria 3101, Australia. Tel: +61 1800 036 186, Fax: +61 (03) 9853 0342. Ring file 2132p. ISBN 1-86339-173-8.

Environmental Audit Guidebook

The *Environmental Audit Guidebook* looks at a range of aspects of the environmental audit, from definitions and history to advice and guidelines for implementation. All aspects are well illustrated by numerous case studies.

Graham Brown (1996). Centre for Professional Development (Aust.) Pty Ltd., ACN 006 964 076, 1st Floor, 35 Cotham Road, Kew, Victoria 3101, Australia. Tel: +61 1800 036 186, Fax: +61 (03) 9853 0342. Ring file 1434p. ISBN 1-86339-087-1.

Motor Vehicle Air Pollution: Teacher's Guide

The adverse health effects caused by motor vehicle air pollution and noise means that these issues are often placed at the top of the list of environmental health problems in those rapidly industrializing countries where rising living standards are leading to patterns of vehicle use similar to those in developed countries. In recognition of the importance of the problem worldwide, the World Health Organization (WHO) and the Exitoxicology Service of the Department of Public Health in Geneva have produced a joint report – *Motor Vehicle Air Pollution: Public Health Impact and Control Measures* – on global trends in motor vehicle pollution, its effects on public health, and available control measures. *Motor Vehicle Air Pollution: Teacher's Guide* was developed to be used in conjunction with the report, to provide a basis for rational discussion of the issues by administrators who will be responsible for air quality management. Both of these documents are available from the following address:

Urban Environmental Health, World Health Organization, 1211 Geneva 27, Switzerland. Tel: +41 (22) 791 4261, Fax: +41 (22) 791 4127.

Environmental Protection: Review of European Union Legislation Up to January 1, 1997

This Review contains all European Commission proposals and measures adopted by the Council of Ministers of the European Community or the European Commission.

The date of publication or adoption of each measure, precise details of the Official Journal of the European Community in which they appear, and the subject matter of the text are given.

The measures are classified in nine major sectors: Water; Air – climate change; Chemical – dangerous substances; Noise; Waste; Land – natural, agricultural; Flora and fauna; Other actions; and Nuclear safety. Each sector is subdivided into: Texts adopted; Texts pending; and Reports and communications.

(1997). EIS s.a., 66 av. Ad. Lacomblé, B-1030 Brussels, Belgium. Tel: +32 (2) 737 77 09, Fax: +32 (2) 732 67 57. Pbk, 70p.

Consumer Labeling Initiative – Phase 1 Report

This report describes the work undertaken in the first phase of the US Environmental Protection Agency's Consumer Labeling Initiative and presents results. The initiative was launched to foster pollution prevention, empower consumer choice ,and improve consumer understanding of safe use of household products and of environmental and health information on consumer product labels. The initiative is a multi-phased project focusing on indoor insecticides, outdoor pesticides, and household hard surface cleaners.

In the initial phase, covered by this report, the EPA and its partners gathered information on how to design clear and informative product labels to aid consumers in making choices. The work which this involved breaks down into three sections, reflected in the structure of the report. These sections cover qualitative consumer research, a literature review of relevant publications, and a review of stakeholder comments. The qualitative research includes 135 one-to-one interviews with users of products to ascertain, amongst other things, whether they read, understand and take advice from labels. The major findings of the research are presented together with an appreciation of consumers' interpretations of terms such as "danger", "caution" and "warning".

The literature review provides a synopsis of a wide range of consumer labeling research, giving background information which can be helpful in interpreting results of primary research. Stakeholder comments, in response to a Federal Register Notice inviting interested parties to submit data and ideas, are analyzed and the report ends with a summary of the findings.

(1996). Work Assignment Manager, Pollution Prevention Division, Office of Pollution Prevention and Toxics, US Environmental Protection Agency (7409), 401 M Street, SW Washington, DC 20460, USA. Tel: +1 (202) 260 4000. Pbk, 165p.

Ecological Issues and Environmental Impact Assessment

This is the latest addition to the Advances in Environmental Control Technology series. It contains 802 pages addressing global environmental and ecological issues and providing an overview of the ecological aspects of environmental ecology, urban ecology, rural planning, land use, and pollution.

The first three chapters cover issues, impact statements and risks for urban planning and industrial facilities. Chapter 4 assesses ecological trends and their relationship to pollution.

Chapters 5 to 17 discuss the impacts of pollutants on soil, groundwater and vegetation. Chapter 18 is a detailed treatise on semivolatile hydrophobic chemicals and chapter 19 discusses the impact of pollution on wildlife and fisheries. This is followed by five chapters dealing with ecological aspects of vegetation and treatment technologies. Chapters 26 and 27 discuss predictive techniques for studying ecological trends and provide detailed discussion of the role of agriculture in environmental pollution. Chapters 28-31 cover the various aspects of how pollution impacts aquatic life.

Paul N. Cheremisinoff, ed. (1997). Gulf Publishing Company, P.O. Box 2608, Houston, Texas 77252-2608, USA. Tel: +1 (713) 520 4444, Fax: +1 (713) 520 4438. Hbk, 802p. ISBN 0-87201-238-7.

The Disaster Can Be Averted

In *The Disaster Can Be Averted*, the author makes an impassioned appeal for an end to the environmental destruction in his native Ukraine. The book first describes how degradation has come about in recent years and looks at the extent of problems of air, ground and water pollution, as well as giving an analysis of the Chernobyl disaster. It then goes on to point some ways forward.

Written originally as a rallying cry to the author's fellow Ukrainians, *The Disaster Can Be Averted* is of interest to a wider audience not only because it details the problems of a particular area (although a wealth of detail is given) but because it shows, above all, that the present poor state of the Ukrainian environment is the result of misguided political will combined with the acquiescence of an apathetic population. The author shows how human will and human actions, in Ukraine or anywhere else in the world, can either destroy or protect our environment.

Mikhail Pozhivanov (1996). Salfra Group, Via Ciseri, 8 – 6900 Lugano, Switzerland. Tel: +41 (091) 922 2305. Hbk, 270p.

Servicing Innovative Financing of Environmentally Sustainable Development

Servicing Innovative Financing of Environmentally Sustainable Development, an Earth Council/World Bank Associated Event held at the World Bank's headquarters 2-3 October 1995, provided a unique opportunity for 75 representatives of the World Bank, the Earth Council, National Commissions on Sustainable Development, and global networks to discuss modalities for innovative financing.

The contributions to the event were presented in three fora: Identifying successful experiences and new users; New institutional approaches: innovative mechanisms, tools and techniques; and Effective financing of delivery systems: connecting people to environmentally sustainable development. Selected contributions have been published in this report.

(1996). The International Bank for Reconstruction and Development, The World Bank, 1818 H Street, N.W., Washington D.C. 20433, USA. Pbk, 68 p. ISBN 0-8213-3628-2.

One Decade After Chernobyl – Summing up the Consequences of the Accident

The proceedings of this international conference, sponsored jointly by the European Commission, IAEA and WHO in cooperation with UNDHA, UNESCO, UNEP, UNSCEAR, FAO and OECD/NEA and held in Vienna 8-12 April 1996, have now been published. The two major objectives of the conference were to reach agreement on established scientific facts and to clarify their interpretation in order to promote comprehension of the Chernobyl accident and help dispel misapprehension.

International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

Procedures for Conducting Probabilistic Safety Assessments of Nuclear Power Plants (Level 3): Off-Site Consequences and Estimation of Risks to the Public

This report provides insights into the relative importance of accident prevention and mitigating measures, expressed in terms of the adverse consequences for the health of the public and contamination of land, air, water and foodstuffs.

International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

A Shared Vision: Toward Sustainability in North America

When Canada, Mexico and the United States signed the North American Free Trade Agreement (NAFTA) in 1993, they created the world's largest trading bloc. During negotiations fears were expressed that the association of countries with such different approaches to environmental issues could cause problems, with some countries using lower environmental standards to encourage inward investment. As a response to such fears, the signatories to NAFTA built environmental safeguards into the trade liberalization pact by also signing a side accord, the North American Agreement on Environmental Cooperation, and by creating the Commission for Environmental Cooperation (CEC). Under the environmental cooperation agreement each country retains its national sovereignty with regard to use of its resources, makes its own environmental laws, and sets its own standards.

A Shared Vision: Toward Sustainability in North America describes the background, operation and aspirations of this unique agreement.

(1997). Communications and Public Outreach Coordinator, Commission for Environmental Cooperation, 393, rue St-Jacques Ouest, bureau 200, Montréal, Québec, Canada H2Y 1N9. Tel: +1 (514) 350 4300, Fax: +1 (514) 350 4314. Pbk, 36p. ISBN 2-922305-00-7.

A Grassroots Reflection on Agenda 21

The Environment Liaison Centre International (ELCI), a global network of around 800 non-governmental organizations has produced a report on grassroots attitudes and reactions to Agenda 21, the global plan of action agreed at the Rio Earth Summit conference in 1992. The report gives the results of the participatory process launched by ELCI in which a broad cross section of NGOs and community-based organizations (CBOs) were contacted to assess the usefulness of Agenda 21, determine what actions have resulted from it, and develop recommendations to make it more relevant.

The Environmental Liaison Centre International, P.O. Box 72641, Nairobi, Kenya. Tel: +254 (2) 562015/562022, Fax: +254 (2) 562175. Pbk, 49 p.

Research Partnerships for Common Concerns: Proceedings of the International Conference on Scientific Research Partnership for Sustainable Development – North-South and South-South Dimensions

The conveners of this conference agreed on three main aims: "to call the attention of the scientific community and of decision makers to the value of research for development and to the importance of partnership in research with and among countries in the South; to hear from research workers from institutions both in the South and in the North about the experience they have gained hitherto in research partnerships; to jointly define ways in which research collaboration among dissimilar partners can be efficiently carried out, to search for new forms of institutional partnership, to enhance capacity and institution-building and to create adequate follow-up mechanisms."

(1996). KFPE, Bärenplatz 2, CH-3011 Berne, Switzerland. Tel: +41 (31) 311 06 01, Fax: +41 (31) 312 16 78. Pbk, 192p. ISBN 3-8258-2987-1.

The Outward Bound Earthbook

The Outward Bound Earthbook is a field guide compiled from activities created by the staff of the Outward Bound School of North Carolina. It is intended to assist teachers and parents, or anyone interested in nature or in learning about and appreciating the natural environment.

The book contains upwards of 50 environmentally educational activities. A chart at the beginning of each activity provides a basic overview indicating the time required, optimum group size, materials needed, and the most suitable location. In addition to these activities, the *Earthbook* contains numerous quotations and readings which are both questioning and inspirational in nature.

Larry Crenshaw, ed. (1995). Earthbook, P.O. Box 55341, Birmingham, AL 35255, US. Pbk, 198p. ISBN 0-89732-195-2.

Classified Installations (controlling hazardous facilities)

The purpose of this brochure, published by the French Ministry of the Environment, is to identify issues in planning pollution and risk prevention policies in connection with economic activities. It begins by examining issues such as air, water and noise pollution, and problems of waste disposal, in both the French national and international contexts, before considering the legal and regulatory framework for addressing such issues. A final section looks at actions and results in France.

Ministère de l'Environnement, 20 avenue de Ségur, 75302 07 Sp, Paris, France. Tel: +33 (1) 42 19 20 21. Pbk, 40p.

Manual of Environmental Policy: The EC and Britain

Environmental policy in Britain is now inextricably linked to that of the European Union. This manual sets out all items of EU environmental legislation, together with an account of what has been done in Britain to implement them.

Nigel Haigh, ed. (1995). Cartermill Publishing, Cartermill International Ltd., Maple House, 149 Tottenham Court Road, London W1 9LI. UK. Tel +44 (0171) 896 2424, Fax: +44 (0171) 896 2449. Ring binder, 706p.ISBN 1-86067-036-9.

CHEMICALS, POLLUTION AND ACCIDENTS

Programme for the Promotion of Chemical Safety (PCS): Technical Workplan for the Period 1997-1998

This document contains information on activities carried out and meetings organized by the WHO Programme for Promotion of Chemical Safety, which is the Central Unit of the International Programme on Chemical Safety (IPCS), a cooperative venture of UNEP, ILO and WHO.

Additional information on activities undertaken by the International Programme on Chemical Safety are contained in the *Inter-Organization Programme for the Sound Management of Chemicals (IOMC) Inventory of Activities – Summary Report*, along with details on the chemical safety-related activities of the other IOMC Participating Organizations (UNEP, ILO, FAO, WHO, UNIDO and OECD). This inventory is supplemented by a Calendar of Meetings and Events providing information on meetings organized jointly or separately by the IOMC Participating Organizations.

These documents are available from the IOMC Secretariat.

IPCS Environmental Health Criteria publications and Health Safety Guides

The International Programme on Chemical Safety (IPCS) is a joint venture between UNEP, the International Labour Organisation and the World Health Organization (WHO). Publications in the Environmental Health Criteria (EHC) series review the environmental and health effects of exposure to a chemical or group of chemicals and provide guidelines for setting exposure limits. The Health and Safety Guide (HSG) series facilitates the application of these guidelines in national chemical safety programmes. The books are in English (those in the EHC series have summaries in French and Spanish), are priced in Swiss francs (shown here) or US dollars, and are available at a discount in developing countries. The series is available from WHO, Distribution and Sales, CH-1211 Geneva 27, Switzerland, and from sales agents for WHO. The most recent titles are:

EHC 171 – Diesel Fuel and Exhaust Emissions *(1996). Pbk, 389p. ISBN 92-4-157171-3, SF 90.00.*

EHC 180 – Principles and Methods for Assessing Direct Immunotoxicity Associated with Exposure to Chemicals *(1996). Pbk, 390. ISBN 92-4-157180-2, SF 55.00.*

EHC 181 – Chlorinated Paraffins *(1996). Pbk, 181. ISBN 92-4-157181-0, SF 40.00.*

EHC 183 – Chlorothalonil *(1996). Pbk, 145. ISBN 92-4-157183-7, SF 35.00.*

EHC 186 – Ethylbenzene *(1996). Pbk, 101. ISBN 92-4-157186-1, SF 30.00.*

Inventory of IPCS and Other WHO Pesticide Evaluations and Summary of Toxicological Evaluations Performed by the Joint Meeting of Pesticide Residues (JMPR)

This inventory replaces the previous IPCS document *Summary of Toxicological Evaluations Performed by the Joint Meeting on Pesticide Residues*. The new inventory includes an updated summary of JMPR evaluations, including acceptable daily intakes as well as other pesticides evaluated by IPCS and other WHO programmes.

International Programme on Chemical Safety, World Health Organization, 20 Avenue Appia, CH-1211 Geneva 27, Switzerland. Fax: +41 (22) 791 4848. Pbk, 55p.

Air Pollution from Motor Vehicles – Standards and Technologies for Controlling Emissions

This handbook presents a state-of-the-art review of vehicle emission standards and testing procedures and attempts to synthesize worldwide experience of vehicle emission control technologies and their applications in both industrialized and developing countries. It is one of a series of publications on vehicle-related pollution and control measures prepared by the World Bank in collaboration with the United Nations Environment Programme's Industry and Environment Centre (UNEP IE). The handbook was prepared to underpin the World Bank's overall objective of promoting transport development that is environmentally sustainable and least damaging to human health and welfare.

The handbook focuses on technical measures for controlling and reducing emissions from motor vehicles in five chapters. Chapter 1 reviews vehicle emission standards in both developed and developing countries, with emphasis on the two principal international systems of standards, those of North America and Europe. Chapter 2 addresses the question of quantifying vehicle emissions. It discusses the test procedures used both to check compliance with standards and to estimate emissions from vehicles in use, and includes a review of vehicle emission factors (grams of pollutants per kilometre travelled) based on research in developing and developed countries.

Chapters 3 and 4 describe the technologies developed to allow new vehicles to comply with standards and measures to control emissions in use. Chapter 5 looks at the role of fuel technology in reducing vehicle emissions with discussion of the benefits of reformulating conventional fuels and the potential benefits of cleaner alternatives such as natural gas, petroleum gas, alcohols and methyl/ethyl esters derived from vegetable oils.

(1996). Distribution Unit, Office of the Publisher, The World Bank, 1818 H Street, N.W., Washington, D.C. 20433, US. Pbk, 246p. ISBN 0-8213-3444-1.

Released Substances and Their Dispersion in the Environment

This manual is designed to help managers responsible for making Integrated Pollution Control applications by providing them with straightforward, jargon-free guidance on the environmental analysis needed to support their application. Although focusing on the UK, the manual will also be of use to all those affected by the EC Directive on Integrated Pollution Prevention and Control.

The manual concentrates on one of the most important technical aspects of any application under Integrated Pollution Control: analysis–the estimation of quantities of substances released and their dispersion in the receiving environment. A framework, with step by step directions, is provided to help managers pitch their applications at a level which corresponds to the scale of releases and to the potential of those releases to cause harm.

Following on from the analysis section, the manual provides advice on two other stages of the application process: dispersion and fate of releases, and ambient quality. Illustrative material, including good practice from past applicants and a complete worked example, are also provided.

HMSO Publications Centre (mail, fax and telephone orders only), P.O. Box 276, London SW8 5D, UK. Tel. (orders only): +44 (0171) 873 9090, Fax: +44 (0171) 873 8200. For counter service, HMSO Bookshops, 49 High Holborn, London WC1V 6HB, UK. Tel: +44 (0171) 873 0011, Fax: +44 (0171) 831 1326. Pbk, 136p. ISBN 0-11-702010-9.

The Regulation of Major Hazards in France, Germany, Finland and the Netherlands

By 1999 European Union Member States will be expected to have implemented the Seveso II Directive through their national laws and administrative practices, to provide a set of rules by which major hazards can be regulated. The Health and Safety Executive (UK) funded this study on major hazards to help inform understanding of four different regulatory systems–those of France, Germany, Finland and the Netherlands. The aims of the report were to: establish a picture of the legal, administrative and regulatory arrangements for major hazards in the four countries; describe the inspection arrangements; make transparent the approaches used for safety and risk assessment of safety management systems; explore related matters including emergency planning and land use planning; and summarize anticipated changes in the light of the new Directive.

Each of the countries analysed has its own unique system. However, some common threads which emerge are analysed together with differences. The study was based on a programme of interviews arranged by and in consultation with the authorities in each country.

Alan V. Jones (1997). HSE Books, P.O. Box 1999, Sudbury, Suffolk CO10 6FS, UK. Tel: +44 (01787) 881165, Fax: +44 (01787) 313995. Pbk, 258p. ISBN 0-7176-1349-6.

CLIMATE CHANGE

Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies – Draft Version 1.3

This handbook has been developed to give guidance to countries (especially developing countries or those with economies in transition) that are planning to conduct studies on the impacts of climate change and potential adaptation measures. It is designed to assist in organizing studies and in making decisions about the scope and methods of assessment.

The handbook starts with three general chapters. The first gives the seven steps of climate change impact assessment. Chapter 2 describes the process of assessment of adaptation to climate change, and Chapter 3 covers integrated assessment of impacts. Other chapters deal with specific sectors: water resources, coastal zones, agriculture, human health, energy and industry, human settlements, forests, wildlife and biodiversity, and fisheries. Here specific approaches for impact adaptation and assessment are discussed and several suitable approaches, methods and models are described for each sector.

(1997). UNEP Headquarters, Atmosphere Unit, Gigiri, Nairobi, Kenya. Tel: +254 (2) 623 451, Fax: +254 (2) 623 410. Loose leaf, 397 p.

WASTE MANAGEMENT

Transfrontier Movements of Wastes Destined for Recovery Operations: Practical Information for the Implementation of the OECD Control System

This publication is an annex (Annex F) to the Guidance Manual (OECD Environment Monograph N° 96) published in January 1996 as an aid to use of the OECD Control System on Transfrontier Movements of Wastes destined for Recovery Operations within the OECD area.

The information is intended to assist OECD Member countries in the practical implementation of the system, by keeping them accurately informed about specific national measures introduced over and above the provisions of the OECD Control System or departing from those provisions.

(1997). OECD Environment Directorate, 2 rue André Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00, Fax: +33 (1) 49 10 42 76. Pbk, 103p.

Issues in Radioactive Waste Disposal

This is the second report from the International Atomic Energy Agency's Working Group on Principles and Criteria for Radioactive Waste Disposal. All of the topics discussed in the report relate, in some way, to the long time-scales which have to be considered for underground repositories of radioactive wastes. They cover post-closure issues relating to underground repositories, optimization of radiation protection, and interface issues between nuclear safeguards and radioactive waste management.

(1996). Waste Safety Section, International Atomic Energy Agency, Wagramstrasse 5, P.O. Box 100, A-1400 Vienna, Austria. Pbk, 42p. ISSN 1011-4289.

Decommissioning of Facilities for Mining and Milling of Radioactive Ores and Closeout of Residues

There are currently around 420 nuclear power plants operating throughout the world and more are being planned or built. In the past, the need for uranium to fuel these plants led to the opening and development of a large number of uranium mines and milling facilities producing large volumes of residues. The subsequent closure of many of the older uranium mines in the 1980s and 1990s, due to a decrease in demand and an increase in the overall supply, led to the gathering of a considerable amount of experience in decommissioning of uranium mines and milling facilities and in the closeout of tailings impoundments. It is in this context that the International Atomic Energy Association (IAEA) has published *Decommissioning of Facilities for Mining and Milling of Radioactive Ores and Closeout of Residues*, to make some of this experience available to assist those involved in future closures.

(1994). International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria. Pbk, 186. ISBN 92-0-100694-2.

Waste Minimization and Clean Production – Proceedings of the 2nd International Conference, Barcelona 7-9 June 1995

This conference, supported by UNEP, brought together stakeholders from the scientific community, industry, trade unions and government agencies. The papers presented have been translated into English and are now available. They provide an update on the present situation and on the different approaches and methodologies used to achieve a common goal summed up by the axiom: "the best waste is that which is not generated".

To help readers find specific topics of interest, the report is divided into thematic blocks: general studies; methodologies; technologies; human factor and training; and case studies.

(1996). UNEP, P.O. Box 30552, Nairobi, Kenya. Tel: +254 (2) 621234, Fax: +254 (2) 226886/226890.

WATER

Water Pollution Control Technology in Japan

Water pollution is a problem which particularly besets developing countries. In 1990, the UN estimated that nearly 2 billion people worldwide lacked access to clean drinking water. It also reported that 80 per cent of all diseases and more than one-third of untimely deaths in developing countries are caused by contaminated water.

Water Pollution Control Technology in Japan, a publication from the Japanese Global Environment Centre Foundation (GEC), presents examples of technological achievements and innovations from Japanese industry in the area of water pollution control. The publication is intended to provide a source of information for policy and decision makers in an area where literature is still scarce.

(1997). Global Environment Centre Foundation, 2-110, Ryokuchikoen, Tsurimi-ku, Osaka 538, Japan. Tel: +81 (6) 915 4121, Fax: +81 (6) 915 0181. Pbk, 230p.

Water Stress in Europe – Can the Challenge be Met?

Water was chosen as the topic for the first joint State of the Environment (SOE) message from the European Environment Agency and the United Nations Environment Programme. Water stress, which means pressure on the quantity and quality of water resources, exists in many parts of Europe, resulting in serious problems of water shortages, flooding, pollution and ecosystem damage. *Water Stress in Europe – Can the Challenge be Met?* outlines the problems of water quantity and quality in Europe and presents some current and future initiatives to combat water stress.

(1997). UNEP, Regional Office for Europe, Geneva Executive Centre, 9 chemin des Anémones, CH-1219 Châtelaine, Switzerland. Tel: +41 (22) 979 9111, Fax: +41 (22) 797 3420. Pbk, 15p. ISBN 92-9167-025-1.

Water Treatment Chemicals

This book is an international guide to more than 3000 water treatment products classified by trade name, chemical composition, function and manufacturer. It is designed to facilitate the decision-making process for providers of industrial, residential, municipal and commercial water supplies.

Michael and Irene Ash (1996). Gower Publishing Limited, Gower House, Croft Road, Aldershot, Hampshire GU11 3HR, UK. Hbk, 642p. ISBN 0-566-07801-5.

RECYCLING

Development of Asphalts and Pavements Using Recycled Tire Rubber

This report documents the technical progress made in the Development of Asphalts and Pavements Using Recycled Tire Rubber project, funded by the US Department of Energy.

Around 285 million tires are discarded every year. Less than 100 million of these are recycled at present, most of the rest being placed in landfills and other waste sites. A more satisfactory disposal route would be to use ground tire rubber in road building. If all of the waste tire rubber in the US could be combined with asphalt in road construction, this would displace about 6 per cent of total asphalt used and would save around 60 trillion BTUs in energy each year.

(1996). US Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161, US.A Tel: +1 (703) 487 4650. Pbk. 133p.

ENERGY

The Yearbook of Renewable Energies 1995/96

Energy demand in developing countries is growing and the energy needs for economic progress in those areas are vast. *The Yearbook of Renewable Energies* provides a forum for scientists, engineers, manufacturers and politicians to discuss the role renewable energies can be expected to play in the future world energy balance, the situation in the various sectors of industry and recent developments. The yearbook focuses on political and economic actions and events, and contains 48 articles from contributors all over the world.

James & James (Science Publishers) Ltd., Waterside House, 47 Kentish Town Road, London NW1 8NZ, UK. Hbk. 286p. ISBN 1-873936-41-9.

Biomass Energy Systems: Proceedings of the International Conference 26-27 February 1996 (New Delhi)

Biomass has traditionally been the most important source of energy in India and other developing countries and is likely to continue to play an important role in the foreseeable future. Developing and promoting viable technologies to utilize biomass in an efficient manner is therefore a high priority. Such development was the main focus of the International Conference on Biomass Energy Systems held in New Delhi in February 1996. The conference proceedings have now been published in a volume containing 50 papers. These are grouped into sections dealing with: production supply and demand for biomass sources: biomass processing for fuel purposes, including conversion to liquid fuels; biomass gasification, improved cookstoves and biogas technology; biomethanation of municipal solid wastes; and biomass-based power generation including cogeneration at sugar mills. In order to give comprehensive coverage of the major issues relating to biomass energy, the papers included range from the highly technical application-oriented to location-specific case studies.

P. Venkata Ramana and S.N. Srinivas, eds. (1997). Tata Energy Research Institute, Dabari Seth Block, Habitat Place, Lodhi Road, New Delhi – 110 003, India. Hbk. 478p. ISBN 81-85419-25-6.

Rural and Renewable Energy: Perspectives from Developing Countries

A large proportion of the population of the world's developing countries lives in rural areas with agrarian economies. The vast majority of these people are heavily dependent on biomass to meet their energy needs. However, severe pressure on natural resources is rendering rural energy systems increasingly economically and environmentally unsustainable in many regions of the world, resulting in what is sometimes known as "the other energy crisis". Several countries, including notably India and China, have made great efforts to promote renewable energy technologies as a way of addressing this situation. *Rural and Renewable Energy: Perspectives from Developing Countries* provides a synthesis of experience in developing solar, wind, water and biomass resources gathered over the last two decades. It examines both successes and failures in order to provide feedback to formulate policies for better implementation of future programmes.

P. Venkata Ramana, ed. (1997). Tata Energy Research Institute, Darbari Seth Block, Habitat Place, Lodhi Road, New Delhi – 110 003, India. Hbk. 317p. ISBN 81-85419-26-4.

Environmentally Sound Energy Efficient Strategies: A Case Study of the Power Sector in India

During the last decade, India's energy consumption more than doubled from 91 million tonnes of oil equivalent (mtoe) in 1981 to 189 mtoe in 1991. By 1994-5 it had reached 219 mtoe. Most of this additional energy has been derived from coal and oils, fuels which lead to the production of greenhouse-gas emissions.

Environmentally Sound Energy Efficient Strategies: A Case Study of the Power Sector in India is the sixth in a series of working papers on energy and environment issues published by the UNEP Collaborating Centre on Energy and Environment at Risø National Laboratory, Denmark. The study from which the paper was drawn covers: measures for reduction of the auxiliary consumption in thermal power plants; reduction of transmission and distribution losses; demand side management options for high tension industries in Maharashtra; barriers in implementation; and institutional and financial mechanisms.

(1997). UNEP Collaborating Centre on Energy and Environment, Risø National Laboratory, P.O. Box 49, DK-400 Roskilde, Denmark. Tel: +45 (46) 32 22 88, Fax: +45 (46) 32 19 99. Pbk. 86p. ISBN 87-550-2285-5.

Implementation Strategy to Reduce Environmental Impact of Energy Related Activities in Zimbabwe

This report is the fifth in a series of working papers on energy and environment issues published by the UNEP Collaborating Centre on Energy and Environment at Risø National Laboratory, Denmark. The work reported in this document should be seen in conjunction with the Centre's activity in the field of climate change mitigation analysis. The report gives background information on the energy sector in Zimbabwe, considers environmental impacts of energy related activities, and proposes implementation strategies and an action plan.

(1997). UNEP Collaborating Centre on Energy and Environment, Risø National Laboratory, P.O. Box 49 , DK-400 Roskilde, Denmark. Tel: +45 (46) 32 22 88, Fax: +45 (46) 32 19 99. Pbk. 77p. ISBN 87-550-2207-3.

CCT Program Bibliography of Publications, Papers and Presentations

Since 1986 the US Department of Energy has been engaged, with several industrial partners, in the Clean Coal Technology Demonstration Program (CCT Program) to develop and demonstrate a new generation of innovative coal utilization processes. During the 10 years of the CCT Program a considerable amount of material has been published. To assist interested readers in locating material, the Department of Energy has produced a bibliography of CTT Program publications.

For bibliography and CCT Program reports, contact: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, USA. Tel: +1 (703) 487 4600. For other articles and newsletters: U.S. Department of Energy, FE-22, Washington DC 20585, USA.

NATIONAL/REGIONAL

Guidelines for Integrated Planning and Management of Coastal and Marine Areas in the Wider Caribbean Region

Coastal areas throughout the developing world are among the most heavily exploited because of their numerous attractions and rich resources. Because the coastal and insular countries of the Caribbean are no exception, the Regional Co-ordinating Unit (RCU) of UNEP's Caribbean Environment Programme (CEP), on request from the Governments of the Wider Caribbean, has undertaken the development of a regional framework for integrated coastal planning and management in the Wider Caribbean Region. The framework is intended to help organize integrated coastal area management (ICAM) at the national level, and to identify the need for selected regional approaches.

Publication of the *Guidelines for Integrated Planning and Management of Coastal and Marine Areas in the Wider Caribbean Region*, to strengthen the institutional capacity in the region, is a step towards the goal of sustainable development. The guidelines are intended for decision makers and governmental and non-governmental organizations and institutions in general, and for those interested in the planning process for management of marine and coastal resources.

(1996). Regional Co-ordinating Unit, Caribbean Environment Programme, United Nations Environment Programme, 14-20 Port Royal Street, Kingston, Jamaica. Tel: +1809 (922) 9267 to 9, Fax: +1809 (922) 9292. Pbk, 141p.

MAP Technical Reports Series No. 107, 108 and 109

The Mediterranean Action Plan (MAP) Technical Reports Series contains selected reports resulting from the various activities performed within the framework of the components of the Mediterranean Action Plan: Pollution and Research Programme (MED POL), Blue Plan, Priority Actions Programme, Specially Protected Areas and Regional Marine Pollution Emergency Response Centres for the Mediterranean.

Three new reports are now available:

No. 107: *Guidelines for Authorizations for the Discharge of Liquid Wastes into the Mediterranean Sea*. Pbk, 200p. ISBN 92-87-1614-X.

No. 108: *Assessment of the State of Microbiological Pollution of the Mediterranean Sea*. Pbk, 270p. ISBN 92-807-1615-8.

No. 109: *Survey of Pollutants from Land-Based Sources in the Mediterranean*. Pbk, 188p. ISBN 92-807-1616-6.

Coordinating Unit for the Mediterranean Action Plan, United Nations Environment Programme, Leoforos Vassileos Konstantinou, 48, P.O. Box 18019, 11610 Athens, Greece.

DIRECTORIES

Environmental Protection Technology 1997

Environmental Protection Technology 1997 contains over 650 brief summaries of technologies which can be used in virtually all areas of environmental protection. Full contact details are given with each summary report, to allow readers to follow up on items about which they require further information.

(1997). Strategy Publications, 4th Floor, Britannia House, 960 High Road, London N12 9RY, UK. Tel: +44 (181) 446 51441, Fax: +44 (181) 446 3659. Pbk, 118.

The Directory of Impact Assessment Guidelines

The purpose of the second edition of this directory is to make guideline documents known and more accessible to those involved in the impact assessment process. The lack of awareness of existing literature has led to much duplication of work, representing a considerable waste of human and financial resources. The directory is intended for planners, decision makers, practitioners and institutions with a mandate for or professional interest in promoting, advertising or managing impact assessment.

(1995). Environmental Planning Group, International Institute for Environment and Development, 3 Endsleigh Street, London WC1H 0DD, UK. Tel: +44 (171) 872 7314, Fax: +44 (171) 388 2826. Pbk, 184p. ISBN 0-905347-99-4.

The World Directory of Renewable Energy Suppliers and Services 1996

This is the second edition of the *World Directory of Renewable Energy Suppliers and Services*. In addition to providing contact details for suppliers and service providers from all regions of the world and in virtually every field connected with renewable energy, the directory contains articles, both general and on specific subjects, putting renewables into their general context and providing technical insights into new developments.

(1996). James & James (Science Publishers) Ltd., Waterside House, 47 Kentish Town Road, London NW1 8NZ, UK. Pbk, 544p. ISBN 1-873936-56-7.

EDITIONS FRANCAISES

Vade-mecum sur le management environnemental

Dans le contexte actuel de prise de conscience concernant les problèmes d'environnement tant au niveau local que global, les entreprises auront à trouver dans les dix ou vingt années à venir de nouvelles stratégies fondées sur la notion du développement durable.

Le vade-mecum, destiné aux chefs d'entreprise, explique l'intérêt du management environnemental et les critères des dispositifs de reconnaissance de ce management que constituent la nouvelle norme ISO 14000 et l'adhésion à l'éco-audit.

(1997). Entreprises pour l'Environnement, 5 esplanade Charles de Gaulle, 92733 Nanterre Cedex, France. Tel : +33 (01) 47 24 64 55, Fax : +33 (01) 47 24 61 77. Poche, 24p. ISBN 2-9508030-5-9.

Que sais-je ? – Les énergies renouvelables

Ce nouveau titre dans la série *Que sais-je ?* décrit les sources d'énergie renouvelables les plus communes : le soleil, le vent, l'eau (rivières, fleuves et océans), la géothermie et la biomasse. L'énergie des déchets, souvent assimilée aux énergies renouvelables, est également comprise dans cette dernière catégorie, aussi appelée " la houille verte ".

Toutes ces sources d'énergie sont présentées du point de vue technologique avec, par exemple, des descriptions des différents types de dispositifs solaires ou les différentes techniques de combustion du bois (carbonisation, gazéification, etc.). Outre ces aspects purement technologiques, l'ouvrage donne des éléments d'analyse du potentiel économique de ces énergies.

Jacques Vernier (1996). Presses Universitaires de France, 108 boulevard Saint-Germain, 75006 Paris, France. Poche, 127p. ISBN 2-13-048323-2.

Le transport aérien et l'environnement – premier bilan quantitatif des nuisances environnementales générées par le transport aérien

Ce document constitue le rapport de synthèse de l'étude " Transport aérien et environnement " initiée par l'Agence de l'Environnement et de la Maitrise de l'Energie française (l'ADEME) et réalisée par Transconsult.

Dans une optique d'étude large, le rapport tient compte de l'évolution des aéroports et de leur transformation en "aérovilles" ou pôles de développement. Cette perspective conduit à s'intéresser aussi bien aux nuisances directes du transport aérien qu'à d'autres modifications, moins évidentes, de l'environnement. L'étude passe en revue un ensemble de problèmes, à savoir : le bruit, la pollution de l'air, la pollution de l'eau, le problème des déchets, la densification de la circulation et les problèmes d'encombrement, la consommation et les neutralisations d'espace et les pollutions diverses (bang sonique, incidence sur la couche d'ozone, impact sur les oiseaux, trainées de condensation…).

Les résultats de l'étude confiée à Transconsult forment un document volumineux. Il a donc été jugé utile de rédiger une synthèse présentée selon le schéma suivant : préambule et présentation générale ; analyse et présentation de la situation actuelle ; données sur l'évolution des gênes, nuisances et pollutions ; analyse de mesures déjà prises ou envisagées en vue de réduire ces gênes, nuisances et pollutions ; suggestions concernant les mesures à prendre pour améliorer la situation actuelle et prévisible.

(1996). Tranconsult, 306 Bureau de la Colline,

92213 Saint-Cloud Cedex, France. Tél : +33 (1) 47 41 47 48, Fax : +33 (1) 47 01 44 28. Poche, 52p.

Les techniques de stabilisation des déchets industriels spéciaux

Ce document fait le point des connaissances aujourd'hui acquises à l'Agence de l'Environnement et de la Maitrise de l'Energie française (ADEME) dans le domaine des procédés de stabilisation des déchets industriels spéciaux. En effet, depuis le 30 mars 1995, les déchets de cette catégorie doivent subir un procédé réduisant leur perméabilité à l'eau et leur fraction lixiviable et améliorant leur tenue mécanique afin d'assurer leur conformité à des critères réglementaires avant mise en décharge. La stabilisation est un terme générique qui regroupe différentes techniques : la solidification, la fixation chimique, la fixation physique ou enrobage ou encapsulation, la vitrification.

Les techniques de stabilisation des déchets industriels spéciaux présente l'aspect réglementaire, ainsi que les définitions et objectifs des procédés de stabilisation. Le document fait également le point sur les différents procédés disponibles et comprend une fiche technique et un schéma de principe pour chacun d'entre eux. Il conclut par un examen des recherches engagées et des voies de progrès envisagées par l'ADEME dans un avenir plus ou moins proche.

(1996). ADEME, Centre d'Angers, 2 square Lafayette, BP 406, 49004 Angers Cedex 01, France. Tél : +33 (2) 41 20 41 20, Fax : +33 (2) 41 87 23 50. Poche, 105p. ISBN 2-86817-129-X.

Les déchets industriels banals dans l'entreprise – approche socio-économique d'opérations innovantes de gestion des DIB

Les déchets industriels banals (DIB) sont définis par l'Agence de l'Environnement et de la Maitrise de l'Energie française (ADEME) comme "les déchets non inertes et non dangereux générés par les entreprises (commerce, artisanat, industrie et activités de service). La mission de l'ADEME dans ce domaine est de favoriser le développement de solutions nouvelles tant techniques qu'organisationnelles. Dans ce cadre, l'ADEME a conduit une étude sur les opérations innovantes de gestion des DIB. Il s'agissait en particulier d'en comprendre les processus de choix, de mise en place et de réussite ou d'échec. Un rapport de synthèse de ces travaux est maintenant disponible.

La réalisation de l'étude a été confiée à des équipes de recherche en sociologie, en gestion et en économie. Chaque équipe a fait un compte rendu détaillé des études de cas réalisées. C'est à partir de ces comptes rendus détaillés que le rapport de synthèse a été rédigé. Il s'appuie sur l'ensemble des cas présentés dans les comptes rendus détaillés pour proposer des solutions innovantes pour la gestion des DIB.

(1996). ADEME, Direction Prospective, Programmation, Evaluation, 27, rue Louis Vicat, 75015 Paris, France. Tél : +33 (1) 47 65 20 00, Fax : +33 (1) 46 45 52 36. Poche, 79p.

MDE : l'éclairage en France

Cette étude, présentée dans le septième numéro des cahiers du Club d'Ingénierie Prospective Energie et Environnement (CLIP), est le résultat d'un travail collectif entrepris par six équipes de recherche d'origine très diverses. L'étude porte sur la maitrise de la demande (MDE) dans le secteur de l'éclairage en France. A l'initiative du Programme Ecotech et avec le soutien financier de deux autres partenaires du CLIP, l'Agence de l'Environnement et de la Maitrise de l'Energie française (ADEME) et le Ministère de l'Environnement, les équipes, constituées de physiciens, d'ingénieurs, d'économistes, de sociologues, de spécialistes du commerce, du marketing et de l'analyse industrielle, se sont regroupées dans une action de recherche coordonnée (ARC) nommée " ECODIFF " . Le but de l'ARC était d'étudier les conditions institutionnelles, économiques, financières, fiscales, réglementaires, etc., des politiques de diffusion sélective du progrès technique à des fins de préservation des ressources naturelles. L'éclairage est exemplaire, à bien des égards, des problèmes que rencontrent les différents acteurs pour diffuser auprès du grand public des innovations technologiques susceptibles d'avoir un effet significatif à la fois sur la consommation énergétique des ménages et sur la courbe de charge du producteur d'électricité.

L'étude aborde la question des instruments d'orientation dont dispose la puissance publique, de leur efficacité et de leur influence sur le fonctionnement du marché. Les deux premiers chapitres présentent les enjeux énergétiques de la maitrise des consommations dans le secteur de l'éclairage et les perspectives technologiques offertes par les stratégies d'innovation des firmes.

Le troisième chapitre identifie les principaux acteurs concernés par la diffusion des lampes fluorescentes compactes (LFC) et leurs comportements à cet égard. Les quatrième et cinquième chapitres analysent les programmes de promotion de la diffusion des technologies d'éclairage efficientes mis en oeuvre au plan international, dans les départements français d'outre-mer et en France métropolitaine. Sont détaillés les différents instruments utilisés pour susciter l'adoption des LFC par les consommateurs. Leurs impacts sur le marché des lampes sont également analysés et comparés.

Enfin, le sixième chapitre tire les enseignements de cette recherche et propose des moyens d'actions pour favoriser la diffusion des LFC dans le contexte français et pour transformer de façon significative et durable les comportements d'achat en faveur des technologies efficientes.

Club d'Ingénierie Prospective Energie et Environnement, 1 rue du Cerf, 92195 Meudon, France. Poche, 80p.

Prospective technologique de l'énergie

Le Groupe de prospective "Energie", réuni au Commissariat général du Plan, a souligné la nécessité d'une plus grande flexibilité dans le système énergétique français. Il a souhaité que les problèmes technologiques soient tout spécialement étudiés par un groupe d'experts. Ce volume assure l'édition du rapport de ce groupe qui a notamment étudié l'accroissement des ressources nationales d'énergie; le redéploiement et les substitutions entre les différentes sources d'énergie; la réduction des consommations; l'amélioration de la facture énergétique; la qualité de l'environnement. Le rapport indique les coûts de différents programmes et les domaines scientifiques qu'il convient de promouvoir au niveau de la recherche publique. L'ensemble des ces informations montre quels sont les enjeux des efforts à consentir d'ici 2010.

(1991). La Documentation Française, Paris, France. Poche, 231p. ISBN 2-11-002577-8.

Techniques, politiques et mesures d'atténuations des changements climatiques

Ce document du Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC) donne un aperçu et une analyse des techniques et des mesures destinées à limiter et à réduire les émissions de gaz à effet de serre et à renforcer les puits de ces gaz, au titre de la Convention-cadre des Nations-Unies sur les changements climatiques.

Le document commence par l'examen de trois secteurs d'utilisation finale de l'énergie, à savoir les bâtiments à usage commercial, résidentiel et institutionnel, les transports et l'industrie. Suit un chapitre consacré au secteur de l'approvisionnement en énergie, qui produit et transforme l'énergie primaire de manière à alimenter en énergie secondaire les secteurs d'utilisation finale. Les chapitres suivants sont consacrés aux techniques et aux mesures susceptibles d'être adoptées dans les secteurs de l'agriculture, des forêts et de la gestion des déchets.

(1996). UNEP, P.O. Box 30552, Nairobi, Kenya. Tél : +254 (2) 621234, Fax : +254 (2) 226886/226890. Poche, 98p. ISBN 92-91-69200-X.

L'eau, la ville et l'urbanisme

Ce numéro de la revue trimestrielle de l'Institut d'Aménagement et d'Urbanisme de la Région d'Ile de France (l'AURIF) présente le rapport de synthèse d'une réflexion menée par l'Académie de l'Eau sur les rapports qu'entretiennent l'eau, la ville et l'urbanisme. L'objectif de l'Académie était d'étudier les relations entre la gestion du cycle de l'eau et l'urbanisation, pour comprendre leurs effets réciproques et mesurer la part due au manque de concertation et d'échange entre ces deux domaines dans les difficultés rencontrées par les villes en expansion.

Vingt-trois villes dans dix-huit pays (développés et en voie de développement) ont accepté de collaborer avec l'Académie de l'Eau. Les leçons tirées des monographies résultant de cette collaboration sont regroupées et classées dans ce document.

(1997). Institut d'Aménagement et d'Urbanisme de la Région Ile de France, 15, rue Falguière, 75740 Paris Cedex 15. Tél : +33 (1) 53 85 79 37.

Technologie, éthique et société : utopie ou nécessité pour demain

Les actes du colloque *Technologie, éthique et société : utopie ou nécessité pour demain*, qui a eu lieu à l'Assemblée Nationale le mardi 4 Juin 1996, ont été publiés. Les experts invités ont présenté des exposés et ont débattu des thèmes suivants : Ethique et risque écologique ; Ethique et technologies de l'information et de la communication ; Ethique et génie génétique : Dialogue démocratique et gestion de risque.

Compte rendu réalisé par la société Hor Ligne – Paris, France. Tél: +33 (1) 41 10 04 80.

◆

Company environmental reporting

Since I was so fortunate as to participate in the meeting in Paris about the Engaging Stakeholders report published by UNEP and Sustainability Ltd., my former department has worked on improving our own company environmental report.

In our report reference is made to the UNEP/Sustainability report, which we used as an important source of benchmarking information and inspiration.

I am convinced that a continuation of benchmarking, in this competent form, and with the support of UNEP, will be an important factor in ensuring an increased number of reporting companies and – even more important – the continued competition to make reports of the highest quality.

Troels Andersen
Director
Long Products Division
Danish Steel Works Ltd.
DK-3300 Frederiksvaerk
Denmark

Environmental management of industrial estates

Nous venons de recevoir le dernier volume (octobre-décembre 1996) de la revue *Industry and Environment*. Je voudrais personnellement vous féliciter pour la très grande qualité de cette revue. Les articles sont de haute tenue et l'information sur les événements et publications est très précieuse.

M. Mercier
Directeur
Programme international sur la sécurité des substances chimiques
Organisation Mondiale de la Santé
CH-1211 Genève 27
Suisse

THE ROLE OF UNEP INDUSTRY AND ENVIRONMENT

It is now widely accepted that sustainable development and a sound environment go hand-in-hand. UNEP recognized this as early as 1975 when it established the Industry and Environment centre (IE), located in Paris. UNEP IE functions as a catalyst to bring industry, government and non-governmental organizations together to work towards environmentally sound forms of industrial development. UNEP IE seeks to:

◆ define and encourage the incorporation of environmental criteria in industrial development;

◆ help formulate policies and strategies for sustainable industrial development and facilitate their implementation;

◆ promote preventive environmental protection through cleaner production and other pro-active approaches; and

◆ stimulate the exchange of information on environmentally sound forms of industrial development.

To achieve these goals, UNEP IE has developed programmes in the fields of Awareness and Preparedness for Emergencies at Local Level (APELL), Cleaner Production, Tourism, Energy, and other sector-specific activities. The OzonAction Programme, under the Multilateral Fund, is also based at UNEP IE. UNEP IE organizes conferences and seminars, undertakes training activities and demonstration projects, and produces practical supporting publications.

To promote the transfer of information and experience, UNEP IE has developed:

◆ The *Industry and Environment* quarterly review;

◆ A *Query-Response Service*, which responds to specific technical queries on a wide range of subjects related to industrial pollution;

◆ *Outreach Activities*, which address a broad range of issues concerning industry as a whole. UNEP IE develops partnerships with industry, government and non-governmental organizations, organizes consultative meetings, and publishes supporting documents aimed at spreading new developments in the field of sustainable development.

◆ A *Technical Report Series*, policy reports and training materials, which provide practical information to readers throughout the world. For a list of available publications, please contact UNEP IE.

◆ Information and exchange clearinghouses, which provide the latest news on cleaner production and OzonAction related activities.

◆ UNEP IE's Web site, to encourage and support the adoption of environmentally-sound technologies and environmental management methods.

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39-43, QUAI ANDRE-CITROEN
73739 PARIS CEDEX 15 - FRANCE
TEL : (33) 01 44 37 14 50
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FEEDBACK

If you would like to respond to something you've read in these pages — to agree or to take issue with a point of view, to clarify a point of fact, or to provide information on a particular aspect — write to us. If you would like to air your views on any other subject relevant to ***Industry and Environment***, we would like to hear from you. As space is limited, we cannot guarantee to publish all letters, nor to publish long ones in full.

Send your Feedback letters to:

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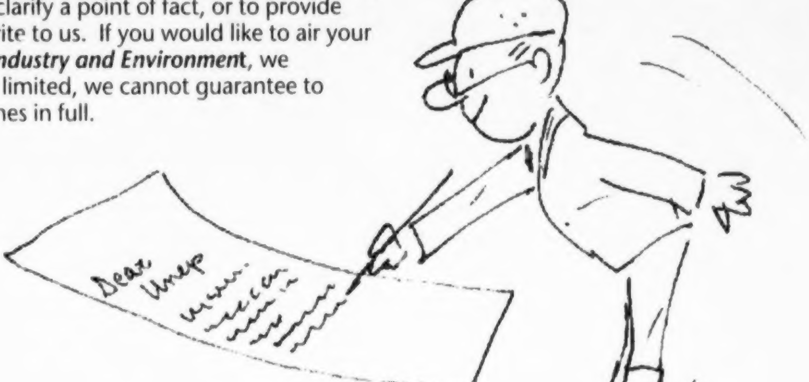

Industry and Environment Review

a publication of the United Nations Environment Programme
Industry and Environment – UNEP IE

For more than fifteen years, the *Industry and Environment* quarterly review has provided a forum for the exchange of research and experience, presenting articles written by and for industry managers, government officials and researchers in the field of sustainable industrial development. In addition to features, news and developments of broad international interest, each issue of the review focuses on a particular theme. Recent issues have covered such varied topics as climate change and industry, education and training, managing contaminated land, transport, and sustainable tourism development. For a complete list of past issues and their availability, contact UNEP IE.

The next issue of *Industry and Environment* will focus on the theme of prevention of industrial accidents.

While *Industry and Environment* is an English language publication, it also includes articles in French and Spanish. All contributed articles are accompanied by summaries in English, French and Spanish.

The review is also available in Chinese. For further details, please contact:
Professor Chen Dingmao, Research Center for Eco-Environmental Sciences, Academia Sinica, P.O. Box 2871, Beijing 100085, China.

INDUSTRY AND ENVIRONMENT SUPPLEMENTS

The *Industry and Environment* review includes four semi-annual supplements: the *APELL*, *Cleaner Production* and *EnTA* newsletters, and *Tourism Focus.*

UNEP IE's APELL programme – Awareness and Preparedness for Emergencies at Local Level – seeks to minimize the occurrence and impact of industrial accidents. The newsletter keeps readers up-to-date on APELL programmes currently in progress around the world.

The Cleaner Production newsletter provides information on cleaner technologies and products, actions by governments and organizations to promote cleaner production, and the UNEP IE Cleaner Production activities and network.

The EnTA newsletter reports on technology assessment as a tool to develop environmentally sound technologies and to discourage the export of those that pose potential environmental hazards.

Tourism Focus reports on developments in the field of sustainable tourism and on the activities of the UNEP Tourism Programme.

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